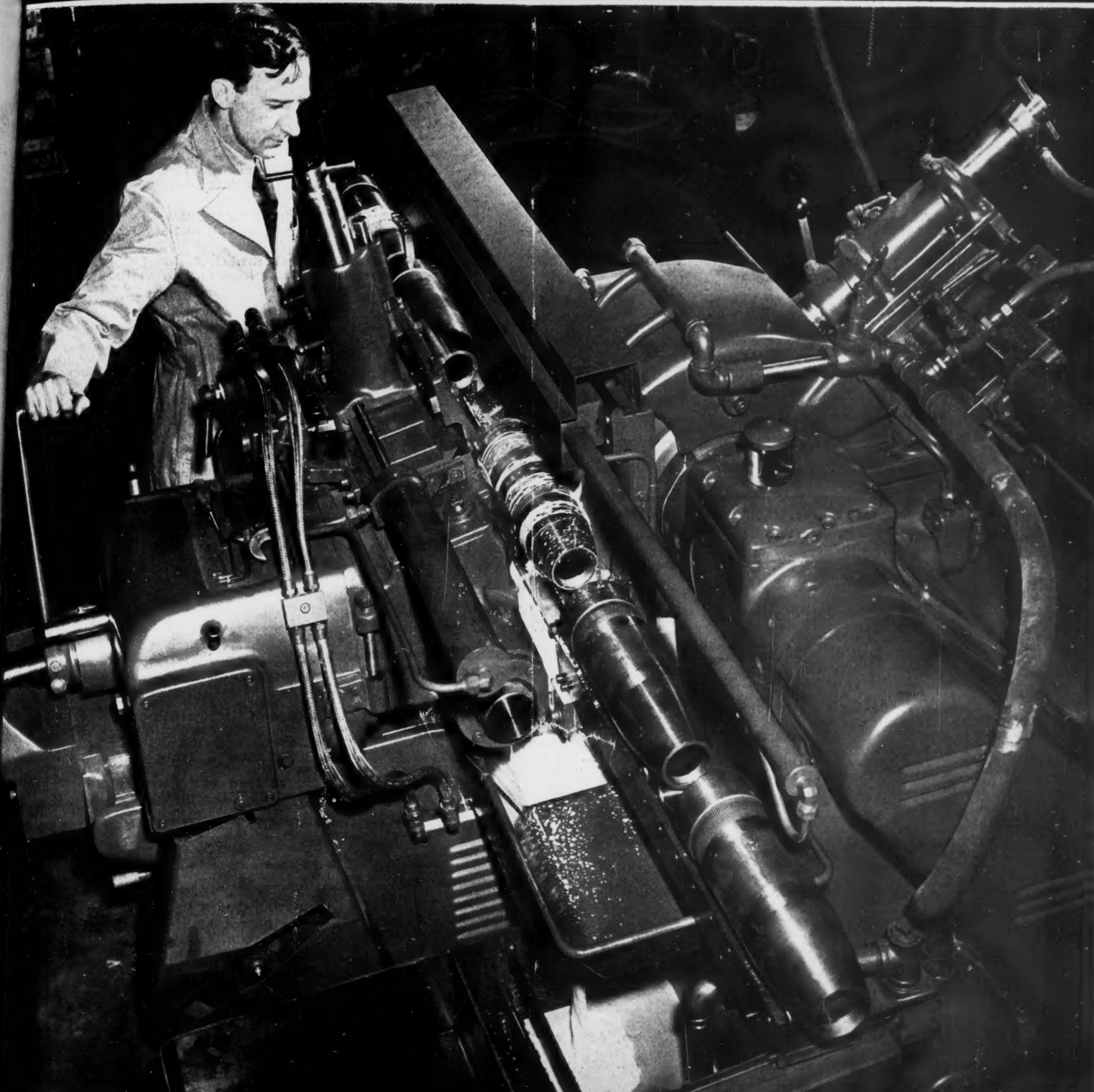
Industrial

Standardization

and Commercial Standards Monthly



December

American Mechanical Standards
Help Coordinate Defense Work
(See Review, Page 321)

1941

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Industrial

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And Commercial Standards Monthly

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RUTH E. MASON, Editor

Our Front Cover: Cincinnati No. 2 centerless grinder grinding the bourrelet diameter of 155-mm shells. Courtesy Cincinnati Grinders, Inc.

This Issue

ASA

Reg. in U.S. Pat. Off.

Standardization is dynamic, not static. It means not to stand still, but to move forward together.

December, 1941

Subscription price $4.00 per year (foreign $5.00); Special to schools and libraries $2.00 (foreign $3.00); single copies 35 cents

Vol. 12, No. 12

Entered as Second Class Matter February 14, 1941, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Technically this has been the biggest year since the American Standards Association began—Sixty-nine new American Standards approved—Sixty-one other American Standards revised to bring them in line with the latest technical developments—Four additional standards completed under the new defense emergency procedure for rushing through the jobs needed by government and industry in defense production.

Every one of these American Standards represents many man-hours of labor. More than 400 national organizations have taken part in the program.

This record is good—as far as it goes—but it does not go far enough.

Participation in the work and familiarity with the resulting standards would make it possible for a large number of additional firms to be carrying their part in the defense program as contractors and sub-contractors. The program has been seriously hampered by the diversity of specifications and requirements for products—acutely so in the case of strategic materials. There is need for a large number of unified American Standard specifications which would be a major factor in developing the whole defense program.

If every one of the present 482 American Standards were ten instead of one—if there were a few thousand more firms active in the ASA program—what a tremendous boon it would be to industry, to government, and to defense!

ASA Approves

New Standard Gage System For Thin Sheet Metals

by H. W. Tenney[1]

Chairman, Subcommittee on Wire and Sheet Metal Gages, ASA Sectional Committee B32

THE practice of ordering uncoated thin flat sheet metal by decimal thicknesses instead of specifying gage number has become more and more widespread in recent years both for ferrous and non-ferrous sheet. For users of a wide variety of materials this has become imperative because of the existence of a number of gage systems, each made up of a series of gage numbers but varying widely in the decimal equivalent for a given gage number.

Many of the systems have interesting historical backgrounds, and for the particular use for which each was created, it served quite admirably at the time. This was particularly true when manufacturing was a local affair. However, as communication and transportation facilities developed and the products of a concern found more and more extended markets, the local gage systems of necessity developed into trade standards; as, for example, sheet steel, strip steel, copper sheet, spring steel, steel wire, music wire, and many others.

When the production of each of the various forms of a material—such as sheet steel, strip steel, steel wire, etc.—was carried out as a separate industry, there was a strong incentive to perpetuate these standards. As combinations took place and one company produced all forms of a material, the old, deeply rooted trade standards persisted. But the persistence of these many gage systems has led to a great deal of confusion.

New standard is first step in unification of methods of gaging thicknesses of sheet metals and metal alloys

Preferred Numbers system is used to provide logical progression of size designations

There are active in American industry today a number of gage systems of which the following are some of the more generally known:

Abbreviation	*Name*	*Principal Applications*
Awg or B & S	American Standard Wire Gage, also known as Brown & Sharpe Gage.	Non-ferrous wire, sheet, and strap. Steel banding wire.
Bwg	Birmingham Wire Gage, also known as Stubs' Iron Wire Gage.	Spring steel (narrow strips). Wall tks of seamless metal tubing.
Stlwg or Nwg	Steel Wire Gage, also known as National Roebling's, or Washburn and Moen's Wire Gage.	Steel wire, except music wire and banding wire.
USg	United States Standard Gage.	Iron and steel sheet. The table shown uses the U.S. Standard Gage iron values for both iron and steel sheet.
Mwg	Music Wire Gage.	Steel spring wire .090 diameter and less.
Tdg	Twist Drill & Steel Wire Gage.	Steel twist drills.
Swg	Stubs' Steel Wire Gage.	Steel drill rod.

Except for the American Wire Gage there is no logical progression. The other systems were

[1]Assistant Director, Research Laboratories, Westinghouse Electric and Manufacturing Company, East Pittsburgh.

developed without much regard for any relationship between successive steps. Furthermore, we find several gage systems have been developed for the same basic material. For example, there are eight different music wire gage systems which enjoy greater or less acceptance.

It is not surprising that users of materials have found themselves in an unhappy position. Where materials are purchased in large quantities, materials of any particular decimal part of an inch in thickness can be obtained without penalty. But where a user must depend upon warehouses to a greater or less degree, or when a user purchases in small quantities direct from the mill, he has to be content with the material conforming to one gage system or another, depending on the form in which the material is desired—as sheet, strip, wire, etc. Furthermore, he is restricted in his shifting from one form of material to another because sheet steel is produced to one gage system and strip steel is produced to another. Going a step further, there are complications in shifting from ferrous to non-ferrous materials for which again the gage systems are quite different.

A sectional committee was organized in 1928 to undertake the standardization of a method of designating the thickness of metals and metal alloys in sheet, plate, and strip form, diameter of metal and metal alloy wires and thickness of tubing, piping, and casing made of these materials. The National Bureau of Standards, as well as several industrial concerns did, over a period of time, prepare data in an effort to stimulate some coordination and unification of existing practices. However, the committee itself was relatively inactive until 1939 when the administrative leadership was assumed by the American Society of Mechanical Engineers.

The nationally representative committee which under the methods of the American Standards Association prepared and recommended the new American Standard for Preferred Thicknesses for Uncoated Thin Flat Metals (Under 0.250 In.) (B32.1-1941) has the following membership:

Arthur L. Townsend, *Acting Chairman*

R. G. Kenly, American Zinc Institute, *Acting Secretary*

American Society of Mechanical Engineers, (Sponsor), *James F. Howe; E. F. Oviatt (alt); Frederick G. Wilson*

Society of Automotive Engineers, (Sponsor), *B. M. Leece; F. G. Whittington*

Air Conditioning and Refrigerating Machinery Association, *W. B. Henderson*

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American Petroleum Institute, *Walter Samans*

American Society for Testing Materials, *R. E. Hess*

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Copper and Brass Research Association, *J. S. McClenahan*

Metal Cutting Tool Institute, *Harry C. Hungerford*

National Association of Purchasing Agents, *A. P. Hickox*

National Bureau of Standards, U.S. Department of Commerce, *H. W. Bearce*

National Electrical Manufacturers Association, *H. W. Samson; H. W. Tenney*

Radio Manufacturers Association, *L. C. F. Horle*

Telephone Group, *R. P. Lutz; J. R. Townsend*

U.S. Navy Department, Bureau of Ships

U.S. War Department, Ordnance Department, *Harry B. Hambleton*

Members-at-Large, *A. P. Cottle; Dr. Paul V. Faragher; William Gould; R. E. Hellmund; L. W. Luff; Randall Salzer; Arthur L. Townsend; C. F. Wolters*

Copies of the standard are available from the American Standards Association at 25 cents each. ASA members are entitled to 20 per cent discount on all approved American Standards purchased through the ASA office.

ASA Company Member Forum Inspired Work

The rejuvenation of this sectional committee was, no doubt, prompted by the many discussions on this subject in the informal meetings of the ASA company member forums. The real need for unification of gage systems was voiced again and again at these gatherings.

At a meeting of the new sectional committee on November 3, 1939, the scope of the activity as defined by the previous committee was accepted and a subcommittee was appointed to study the subject in detail and prepare recommendations. The subcommittee decided that to undertake all phases of this project at the same time would be covering entirely too much territory. Consequently, it was decided that efforts would be first concentrated on a standard for thickness of thin flat uncoated metals under ¼ inch in thickness. Comparative tables and charts were prepared giving most of the more generally used systems in an attempt to see how they might be coordinated.

From a study of these, certain general principles gradually developed:

(1) Decimal parts of an inch should be used in designating thickness to avoid confusion with the numbers of the many existing gages. It was interesting to note that many users were already using the decimal designation.

(2) The use of a single system of decimal thicknesses for all metals and alloys would eliminate confusion in substituting one material for another or even substituting different classes of the same material.

(3) The steps in such a system should form some logical progression.

(4) The system should be flexible enough so that intermediate sizes could be added if need be which would have some logical relationship to the main thicknesses.

The ASA had already provided a very useful tool in the system of preferred numbers and this seemed to largely satisfy the general requirements. In the first place each series in the preferred system is a geometric progression with each succeeding step a definite percentage larger than the preceding one. All of the series are related so that if one desires more steps in a given range than the selected series offers, he may include steps of another series. In the second place, the several series of preferred numbers as presented by the American Standard are expressed in decimals.

The remaining question was whether one series of preferred thicknesses could be generally accepted for sheets of different metals and different alloys. It was found by comparing the 20-series of the preferred number system to the several gage systems that this single series adequately met most general-purpose needs for both ferrous and non-ferrous sheet. In a great majority of cases materials produced according to the 20-series of preferred numbers could be readily substituted for sheet produced by any one of the several gage systems. It was recognized that where material was used for deep drawing operations and close control of thickness is paramount, immediate substitution of material produced by the preferred thicknesses could not be effected. It would be necessary to continue a few sizes purchased according to old gage systems during the life of the design or until new dies were justified. It was also recognized that for many applications, particularly the tonnage requirements of mass-production industries, thicknesses, more frequently than not, are determined by critical engineering design or manufacturing considerations. For these special requirements, all decimal thicknesses of metals contingent on application would continue to be recognized as commercial and in no way construed to be non-standard.

Proposed Standard Circulated Widely

A proposed standard using the 20-series of the preferred number system was prepared and given wide circulation among warehouses and producers of all thin flat material. The response to the request for criticism was most gratifying. The care with which the comments were prepared and the number of replies which were received was another measure of the intense interest in this problem of gage systems. Many helpful suggestions and criticisms were received, and using these as a basis the proposed standard was revised. It was then presented to the sectional committee. After approval by the sectional committee it was sent to the ASA Standards Council and was then issued as an American Standard.

In order to avoid confusion with the many existing gage systems, it was felt that a distinctive name for the new system of designating thicknesses of thin flat metals was very important. The title of "Preferred Thicknesses of Uncoated, Thin Flat Metals" immediately appealed to the sub-group as a descriptive as well as a distinctive one.

Among manufacturers using many different materials and different forms of the same materials, there has been felt a need for a universal system of designating thicknesses. The active discussions on this subject all took place before the present emergency was upon us and even then the need of such a system was thoroughly recognized. Under the conditions existing now, the unification or consolidation of the multitude of gage systems into one system for the designation of thicknesses of thin flat metal should be of tremendous help in meeting the problems of the day.

Foreign Trade Council Votes for All-American Cooperation on Standards

As a first step in the cooperation urged by Cyrus Townsend Brady, Jr., in his address before the National Foreign Trade Council, reported in the November issue of INDUSTRIAL STANDARDIZATION, p 293, the Council's convention voted:

"The Convention records its belief that government and industry should immediately cooperate to establish throughout Latin America a comprehensive acceptance of common materiel standards for manufacture, inspection and maintenance, as a vital step forward in facilitating orderly commercial procedure."

ASTM Considers Asking ASA Approval on More Standards

The American Standards Association has been informed by the American Society for Testing Materials that the ASTM Committee A-1 on Steel is now voting on the question of submitting 32 standards under its jurisdiction to the ASA for approval. These standards are:

Steel Castings

Alloy-Steel Castings for Structural Use (A148-36)
Carbon-Steel Castings for Miscellaneous Uses (Z27-39)
Carbon-Steel Castings for Fusion Welding (A215-41)

Flange and Bolting Materials

Alloy-Steel Castings for Service from 750 to 1100 F (A157-41)
Carbon and Alloy-Steel Nuts for Bolts (A194-40)
Forged or Rolled Alloy-Steel Pipe Flanges for Service from 750 to 1100 F (A182-40)
Forged or Rolled Steel Pipe Flanges (A181-37)

Concrete Reinforcement

Axles-Steel Bars (A160-39)
Fabricated Steel Bar or Rod Mats (A184-37)
Welded Steel Wire Fabric (A-185-37)

Materials for Boilers, Pressure Vessels, etc.

Boiler Rivet Steel and Rivets (A31-40)
Carbon-Silicon Steel Plates for Boilers (A212-39)
Carbon-Steel Plates for Boilers (A70-39)
CMS Plates for Boilers (A202-39)
Low-carbon Ni-Steel Plates for Boilers (A203-39)
Low Tensile Strength Plates of Flange and Firebox Qualities (A89-39)
Molybdenum-Steel Plates for Boilers (A204-39)
Plates for Fusion-Welded Boilers (A201-39)

Structural Materials

Carbon-Steel Plates for Welding (A78-40)
High-Strength Structural Rivet Steel (A195-41)
Structural Silicon Steel (A94-39)
Structural Steel for Locomotives (A113-39)

Pipe and Tubing

Electric-Resistance-Welded Steel Boiler Tubes for High-Pressure Service (A226-40)
Electric-Resistance-Welded Steel and Iron Boiler Tubes (A78-40)
Lap-Welded Steel and Iron Boiler Tubes (A83-40)
Medium-Carbon Seamless Steel Boiler Tubes (A210-40)
Seamless Alloy-Steel Boiler Tubes (A213-40)
Seamless Steel Boiler Tubes for H.P. Service (A192-40)
Spiral-Welded Steel or Iron Pipe (A211-40)

Any comments on the approval of these standards by the American Standards Association should be forwarded to the ASA office promptly. Copies of the standards may be obtained from the ASTM, 260 S. Broad Street, Philadelphia.

Senate Bill Would Give Authority To ICC on Truck Sizes and Weights

A bill to give the Interstate Commerce Commission authority to take action against unduly burdensome local regulations on sizes and weights of motor vehicles engaged in interstate commerce has been introduced by Senator Wheeler (Montana), chairman of the Senate Interstate Commerce Committee. The bill carries out the recommendations of the ICC which followed a survey of the size and weight problem as reported in INDUSTRIAL STANDARDIZATION, November, p 308.

As recommended by the ICC in its report, the bill would authorize any carrier, shipper, association of carriers or shippers, any body politic or municipal organization, to file complaint with the Interstate Commerce Commission when such an organization believes that state or local regulations of motor vehicle sizes and weights constitute an unreasonable burden or obstruction to interstate commerce.

The ICC would be authorized to conduct investigations, and if after prescribed notice and hearing it found the allegations had been sustained, it could order revision of the regulations under complaint.

The Commission would be ordered to give consideration to the character of highways and bridges, the effect of changes in size and weight regulations, and other factors entering into the proposed revisions in state or local procedure.

The bill was referred to the Senate Committee on Interstate Commerce.

Organization of the work of the OPM Bureau of Industrial Conservation, now virtually completed, is announced as follows:

Lessing J. Rosenwald, *Chief*
Paul Cabot, *Deputy Chief*
Conservation and Substitution Branch—Harvey Anderson, *Chief*
Salvage Branch — Paul Cabot, *Acting Chief*
Simplification Branch—E. W. Ely, *Chief*
Specifications Branch—C. L. Warwick, *Chief*

New Cadmium Standard Protects Workers' Health

by Cyril Ainsworth

Assistant Secretary, American Standards Association

SURGEON PAUL A. NEAL of the United States Public Health Service, writing in the February 1941 issue of INDUSTRIAL STANDARDIZATION, stated that a milestone in progress toward protection of workers from the harmful effects of toxic dusts and gases was passed when the American Standards Association gave its approval to four new American Standards defining the amount of carbon monoxide, hydrogen sulfide, carbon disulfide, and benzene which may be permitted in the air of work places without harm to workers.

Another step in that progress was taken through the recent approval of the American Defense Emergency Standard, Allowable Concentration of Cadmium.

The greatly increased technical use of cadmium under the defense program led the ASA Sectional Committee on Allowable Concentration of Toxic Dusts and Gases to suggest to the ASA that such a standard be developed under the emergency procedure.

Following ASA approval of this proposal, the U. S. Public Health Service accepted responsibility for drafting the standard, which was then circulated to the sectional committee for comment and criticism. The criticisms received were reviewed by the executive committee of the sectional committee and suggestions were presented to the U. S. Public Health Service for revision of the proposed standard. A standard incorporating these suggestions was submitted to ASA and was approved November 2, 1941.

Increased Use Increases Dangers

Industry has used cadmium increasingly in electroplating materials and in alloys. Parallel with this increase in its industrial use has come an increased amount of cadmium poisoning. Cadmium is toxic when absorbed either through the lungs or the gastro-intestinal tract.

Cadmium is of the greatest importance as a constituent of alloys and in the form of its compounds. These are used in electrical conductors, jewelry, plating, pigment, ceramics, cadmium vapor lamps, dental amalgams, process engraving, photography, and alkaline storage batteries. The metal is a substitute for tin in antifriction metals and in solders, being very largely used in bearing metals for automobiles. Cadmium is used in electroplating for the purpose of rust-proofing wires, tools, screws, bolts and nuts, and other iron and steel articles.

Where Cadmium Poisoning Occurs

It has been determined that cadmium poisoning may occur in the smelting of cadmium ores, working up of residues, welding of alloys, spraying of cadmium-bearing paints and pigments, production of cadmium compounds, melting the metal and cadmium-plating processes, particularly of marine hardware and other fittings which were formerly zinc coated.

While the new emergency defense standard has been developed for industrial use, a discussion of the toxicity of cadmium would not be complete if attention were not called to the fact that the U. S. Public Health Service during the past year has received information concerning numerous cases of cadmium poisoning arising from the contamination of food or drink with dissolved cadmium salts. This has occurred through the preparation or storage of food or drink in cadmium-plated containers. Metallic cadmium dissolves in the acids normally present in certain foodstuffs and a poisonous cadmium compound is formed. When this compound is ingested it causes acute poisoning very similar to so-called "food poisoning." Prior to 1941 a total of 20 cases of cadmium poisoning due to the ingestion of cadmium had been reported in the literature. Since January 1941, 315 cases have occurred.

An allowable concentration of cadmium or of its compounds in air of one milligram of cadmium per ten cubic meters of air is prescribed by

the standard. Important chemical and physical properties of the metal are given. The sampling procedure to be followed and the analytical methods to be used are also set forth.

The ASA Sectional Committee on Allowable Concentrations of Toxic Dusts and Gases will welcome information concerning the experiences of individuals or groups in controlling the hazards to the health of workers due to the use of cadmium or its compounds, as well as all other toxic substances. The committee can best serve industry when it knows the problems of industry. Information concerning the substances which cause the greatest difficulty and on which standards need to be developed will be welcomed by the American Standards Association.

ASA Library Receives New Foreign Standards

The following is a list of new and revised standards which have been received recently by the American Standards Association, and which are available to members for loan from the ASA Library.

Australia

SAA Wiring Rules—Electrical Equipment of Buildings, Structures and Premises Part II—Materials No. CC 1, Part II—1941

Canada

Cast Iron Soil Pipe and Fittings, CESA Standard Specifications B70-1941 50¢

Galvanized (Zinc-Coated) Steel Line Wire, CESA Standard, 3rd ed. C3-1941 50¢

Great Britain

Grading Rules for Structural Timber: 800 lb f Grade Redwood, Scots Pine, European Larch, Douglas Fir (Homegrown) 940-1941

Feeler Gages 957-1941

Precision Levels for Engineering Workshops 958-1941

Internal Micrometers 959-1941

Wrought Steels (Carbon and Alloy Steels) TAC 1-33 971-1941

Glazing and Fixing of Glass for Buildings, Code of Practice 973-1941

Symbols for Use on Diagrams of Chemical Plant 974-1941

Density-Composition Tables for Aqueous Solutions of Nitric Acid for Use in Conjunction with BS Density Hydrometers 975-1941; same for Hydrochloric Acid 976-1941

Woollen and Worsted Knitting Yarns (Weights and Packages) for Retail Sale 984-1941

Revised British Standards

Portland Blastfurnace Cement (Superseding 146-1932) 146-1941

Cooker Control Units for Use in 2-Wire Circuits of not more than 250 volts Declared Voltage (Superseding 438-1936) 438-1941

British War Emergency Standards

Tolerances for Plain Limit Gages 969-1941

Synthetic-Resin Bonded Fabric Sheets for Electrical and Mechanical Purposes 972-1941

Definitions of Furnishing Fabrics and Miscellaneous Textile Merchandise for the Distributive Trades 982-1941; 983-1941

Revised British War Emergency Standards

Limits and Fits for Engineering 1941 issue of 164-1927

Dimensions of Common Building Bricks (Superseding 657-1936) 657-1941

Switzerland

Federringe—Technische Lieferbedingungen VSM 12742 S.P. 1 & 2

Rohrleitungen—Hinweise auf ausländische Normen 18579 S.1-12

Schleifscheiben—Serie E Topfscheiben 35326a

ISA-Toleranz-System—Bedingungen für die Abnahme von Werkstücken 58914a

Farbton für den Anstrich von Maschinen und Apparaten: Allgemeine Verwendung 37020 E; Für Sonderfälle 37021 E

Standards Are Studied In Training Courses for Welders

Standards have an important place in the new publication of the International Acetylene Association which outlines a standard training course for welding operators and inspectors. In the section on pipe welding, for instance, an entire training period is assigned to a discussion of the American Standard Code for Pressure Piping and in the section for training of inspectors it is suggested that one session be assigned to codes, standards, and specifications and tests to determine whether a weldment meets the standard requirements.

The booklet, *Training Oxy-Acetylene Welding and Cutting Operators*, was compiled by the Oxy-Acetylene Committee and published by the International Acetylene Association, 30 East 42 Street, New York. Copies are 25 cents.

British Standards Institution Shows Activity in International Cooperation

INTERNATIONAL cooperation and exchange of information were important themes in the British Standards Institution's Annual Report for the period from July 1, 1940 to June 30, 1941, just received by the ASA.

As the result of an arrangement with the Department of Overseas Trade, the Institution maintains complete sets of British Standards Specifications in the hands of the British Commercial Diplomatic and Consular Officers and Trade Commissioners in the chief trading centers of the world, it is reported. Some 3,000 copies of British Standards have been sent abroad during the past year for this purpose. A number of complete sets of British Standards have also been presented to universities and technical institutions in different parts of the world.

British Committee in Argentina is translating Handbook on British Industrial Practice into Spanish; translates Argentine draft standards into English for comment by British manufacturers

250 Articles in Spanish Handbook

A great deal of work is being done in preparing material in Spanish, particularly for use in South America, the report shows. A Spanish Handbook on British Industrial Practice, containing more than 250 articles and tables compiled by experts, is nearing completion. The articles are being translated into Spanish by the British Standards Committee in Argentina and the translations are being passed upon by experienced Argentine technicians. Much of this Spanish material is now already in the hands of the printer. A Buyers' Guide supplement to the Handbook is being issued as a separate publication, giving British manufacturers an opportunity of bringing their products to the notice of South American buyers. The Handbook is divided into 14 sections commencing with materials, testing, and measurement. Nine of the principal British industries are described. In addition, sections are included covering Fundamental Units and Conversions and Industrial Standardization.

The BSI has also decided to issue an English edition of the Spanish Handbook for circulation throughout the British Empire.

Translate Standards Into Turkish

Some of the more important British Standard Specifications are now being translated into Turkish, particularly a number dealing with railway work, and some in the electrical and mechanical fields. In order that these translations may be entirely acceptable they are being submitted to an official appointed by the Turkish Government before being issued. The translations will be printed with the Turkish and English text on opposite pages. In addition, three handbooks are being compiled dealing with fundamental units and conversions, bridge and railway work, and with electrical matters. These are being compiled in collaboration with the

It will be of interest to his many friends in the United States to know that Mr. Percy Good, formerly Deputy Director of the British Standards Institution, has been appointed Joint-Director. Mr. Good has been closely associated for many years with Mr. C. le Maistre, who remains as senior director of the BSI.

"It is gratifying to report," the BSI annual report announces, "that His Majesty, the King, has conferred on Mr. Percy Good, the Joint-Director, the distinction of Commander of the Most Excellent Order of the British Empire, for services to civil defense. Some of the work done by Mr. Good and the Illuminating Engineers associated with him must, for the present, remain unpublished, but it can be reported that its success has in large measure been due to the unique contact which the British Standards Institution has with the Government departments, municipal authorities, and industry."

British industries concerned and with the advice and help of Turkish authorities.

The work of the British Standards Committee in the Argentine Republic has been actively continued during the past year. During the year Argentine draft specifications on 24 different subjects were translated by the committee and sent to the British Standards Institution in London for comment by British manufacturers.

"The important function of standardization in war production, and particularly its aspect of simplification and coordination, has been rapidly recognized and it has become clear that some of the Institution's work which had been suspended has in fact become essential to the war effort," the report declares. "The special conditions resulting from the restriction in the supply of materials have given rise to increasing demands for new and revised standards. In consequence, a number of specifications and revisions which had previously been put on one side have now, at the request both of Government Departments and industry, been completed and issued."

As an indication of the value of this work, it is estimated that the War Emergency British Standard Schedule of Sizes for Tins and Cans has saved 40,000 tons of steel in the first year. The work has now been extended to cover packaging.

The first part of a study on the rationalization of alloy and special steels has now been completed and a British Standard Schedule B.S. 970 has been issued as an EN Series of Wrought Steels. A complementary document, B.S. 971, gives information regarding the use of the various steels and their classification.

An important piece of work carried out by the BSI for the Gages, Jigs, and Tools Department of the Ministry of Supply has resulted in a British Standard for 25 forming tools. Before the war there was wide variation in the tooth form of the gears; one firm, for instance, had some 700 forming tools. The standardization on 25 forming tools will permit the production of hobs in large quantities by semi-skilled labor instead of a restricted production by highly skilled labor, the BSI reports.

A series of War Emergency Building Standards is being prepared by the British Standards Institution for the Ministry of Works and Buildings. These specifications will be used by all the Government Departments concerned.

The preparation of an English edition of the Universal Decimal Classification, which is an extension of the Dewey Decimal Classification, is now being carried on under the supervision of the BSI. This universal classification, which was started at an International Conference of Bibliography at Brussels in 1895, is being prepared to help coordinate abstracts and references to scientific and technological information, particularly bibliographies, in different fields and different languages. Editions of the Classification are published, or are being published, in English, French, and German.

OPM Requests Simplification Of Structural Steel Shapes

All steel producers have been requested by A. D. Whiteside, chief of OPM's iron and steel section, to cooperate in an industry-wide simplification of structural steel shapes. The simplification would reduce the number of angle shapes 50 per cent, and about the same proportion for wide flange beams, light beams, junior beams, standard channels, H-beams, Zees, and Tees. February 1, 1942 is the effective date for the simplification program to take effect.

The request was made, according to the OPM announcement, "to avoid tying up mills with small miscellaneous rollings for odd-size beams, channels, and angles."

According to *Business Week*, November 8, "big producers point to 20 years of effort toward structural steel simplification and standardization, now brought to a realization far more complete than would have been possible without the pressure of war-time demands for their facilities."

However, *Business Week* declares, "Since blast-furnace capacity is at a premium, the producers regret that the new schedule of sizes will call for about 5 per cent more steel (an architect designing a building will in the interests of safety always go from an unavailable light beam to a heavier one that he can get), but believe that all-over steel production will in the long run be increased by larger volumes of standard shapes."

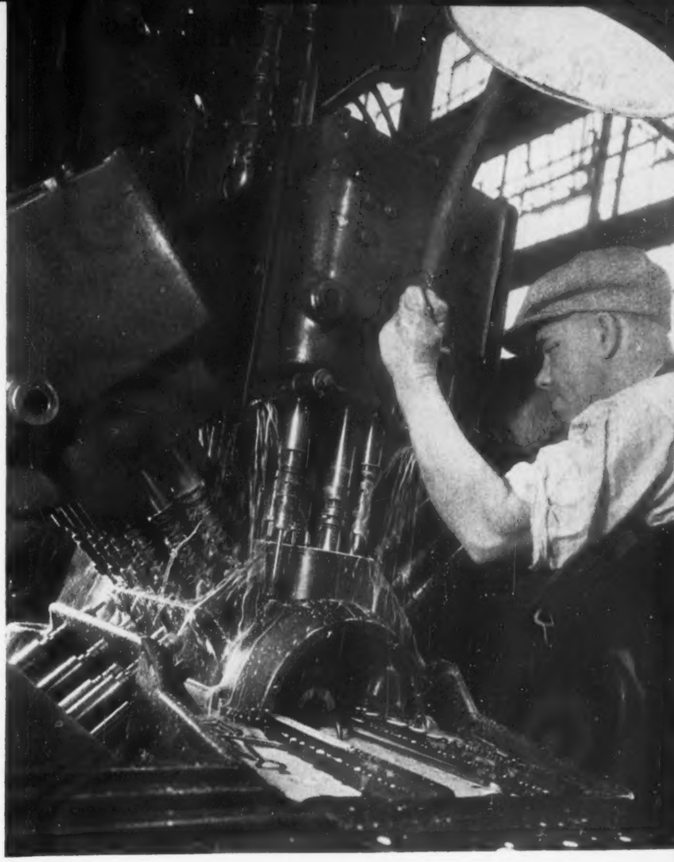
Griswold Represents AGA On ASA Standards Council

Robert G. Griswold, president of Electric Advisers, Inc., New York, has been named by the American Gas Association as its representative on the ASA Standards Council succeeding R. B. Harper, who resigned recently. Mr. Griswold will complete Mr. Harper's unexpired term ending December 31, 1943.

An Automatic Spindle Drilling Machine at Work

The ASA mechanical standards program has so far produced 68 standards (not counting Safety Codes), many of which are used in mass-production operations such as that shown here. The standard for twist drills is one of the important group of American Standards for small tools and machine tool elements.

Courtesy Ford Motor Company



American Mechanical Standards

Made and in the Making

by John Gaillard

Secretary, ASA Mechanical Standards Committee

WITH our country tooling up as the arsenal of the democracies and producing the greatest flow of war equipment in history, American Standards in the mechanical field are doing their part in keeping this flow running smoothly. The mechanical standards developed by industry and governmental groups through the American Standards Association have in peacetime been called "the core of industry's mass-production processes, permeating the entire fabric of manufacture." Now, in time of national emergency, this work takes on an even greater significance.

The American Standards Association has offered its special services to government and industry to coordinate the means of carrying out the national defense program and has adopted the ASA Defense Emergency Procedure to speed up urgent projects in this field. Three standards have already been approved by this "short-cut," emergency method—two for control of quality of manufactured product, developed at the request of the War Department; and one for accuracy of engine lathes, one of the most important tools of defense production.

In 1918, industry suffered for lack of adequate national standards. Since that time a solid framework of standards has been built up by the cooperative efforts of industry and governmental groups through the American Standards Association.

To give the designer, the production man, and the inspector a picture of what has so far been achieved, we are presenting here short descriptions of the mechanical standards approved by the American Standards Association up to November 1, 1941. The scope of each project, given in full, will enable the reader to judge whether a new piece of standardization work that he needs comes under an existing ASA project. From the contents of the standards, the reader may discover data useful in solving his own problems. And

in some cases he may learn of the apparent trend of future developments under a given project.

This review has been prepared from the records at ASA headquarters supplemented by reports from the sponsor groups, the organizations taking administrative leadership in the several projects. It is possible that in the opinion of some ASA committees certain developments of their work, although still in the early stage and not yet brought to the attention of the ASA staff, might well be published for the information of our readers. Such additional information will be welcomed.

Screw Threads (B1)

Scope: Nomenclature of screw threads; form of threads; diameters and pitches of screws for various uses; classification of thread fits, tolerances and allowances for threaded parts; and the gaging of threads. Screw threads for fire hose couplings are not included within this scope.

Sponsors: American Society of Mechanical Engineers and Society of Automotive Engineers.

The American Standard, Screw Threads for Bolts, Nuts, Machine Screws and Threaded Parts (B1.1-1935), is the first revision of a standard which was approved by the ASA in 1924 and was based on the first report of the National Screw Thread Commission published in 1921.[1] In 1931 a nation-wide survey of industrial screw thread practice was made by ASA committee B1 in cooperation with the National Bureau of Standards. The results of this survey and the discussion of certain fundamental questions led to the revision of 1935. The Introduction of the present standard deals with the form of thread; the five screw thread series covered, namely: coarse, fine, 8-pitch, 12-pitch and 16-pitch threads; definitions and symbols, including those designating the kind of thread and class of fit; the four classes of fit between screw and nut; and the tolerances on the major, pitch, and minor diameters. A diagram shows the tolerances and crest clearances for Class 2 and Class 3 fits. Following the Introduction, tables are given for the tolerances and limits of screw and nut, for the classes of fit indicated after each kind of thread, as follows: Coarse Threads (1, 2, 3, 4); Fine Threads (2, 3, 4); 8-Pitch Threads (2, 3); 12-Pitch Threads (2, 3); and 16-Pitch Threads (3). During recent years, committee B1 has given much thought to the question whether the present classes of fit should be modified to some extent. However, it was decided that no such modification should be undertaken during the national emergency to avoid upsetting existing practice in mass production. An Appendix of the standard deals with the Relation of Lead and Angle Variation to Pitch Diameter Tolerances.

[1] The National Screw Thread Commission (NSTC) was abolished in 1933. In 1939, the U. S. Departments of Commerce, Navy, and War jointly organized the Interdepartmental Screw Thread Committee (ISTC) which compiled Handbook H25, Screw Thread Standards for Federal Services published in 1940 by the National Bureau of Standards. It is expected that a revision of this Handbook will be published shortly. The ASA has appointed four liaison representatives on the ISTC to assist the government in coordinating its screw thread practice with that of private industry.

The American Standard, Screw Thread Gages and Gaging (B1.2-1941) (first edition), was approved in September 1941 and copies will probably be available at the time this review is published. It deals with the general fundamentals of gaging practice and thread gaging in particular; specifications for thread gages in three classes of accuracy: W, X and Y (class W being the most accurate); the recommended uses of Go thread gages; and the marking of thread gages. Distinction has been made between the gaging of commercial nuts and the gaging of more exacting threaded products.

The American Standard, Acme and Other Translating Threads (B1.3-1941) (first edition), covers four series of translating screw threads: the General Purpose Acme; the 29-Degree Stub; the 60-Degree Stub; and a Modified Square Thread (10 Degree Included Angle).

Pipe Thread (B2)

Scope: The American (Briggs) Standard taper and straight pipe threads, plumbers' threads, and threads for thin tubes, dimensions of the elements, formulas for calculating the dimensions, gages and working tolerances and methods of gaging.

Sponsors: American Gas Association and American Society of Mechanical Engineers.

The American Standard for Pipe Thread (B2-1919), based on the standard developed by Robert Briggs prior to 1882, was prepared by a joint ASME-AGA committee and in 1919 became the first American Standard in the mechanical field formally approved by the ASA. The first revision of this standard is now practically completed. In addition to the taper and straight pipe threads given in the 1919 edition, the revision covers external and internal taper threads for railing fittings (mechanical joints); taper threads, longer than the regular ones, for assembly with flanges for high pressure-temperature service; straight threads for pressure-tight joints (pipe couplings; oil or grease cup, and other lubrication fittings; and refrigerant, SAE fuel and oil tube fittings) straight threads for mechanical joints; and straight threads for locknut connections. Also, hose coupling threads for nominal pipe sizes from ½ to 2 in., given in the American Standard for Hose Coupling Screw Threads (B33.1-1935) are listed again here.

Manufacturing tolerances on threaded product,

gage specifications, and the method of gaging are also given for the different applications of pipe thread.

American Standard taper pipe threads and threads for API Line Pipe are identical, according to the proposed revision, except for the nominal pipe size of 2 in. Here, the API uses a longer thread (*not* an American Standard thread) which is too long for the chambers in the lower pressure fittings and valves threaded according to the American Standard.

At the time this article was written, submittal of the revision to the sponsors was reported to be waiting only for the results of efforts which are being made to reach agreement on terminology applying to pipe threads, mostly between the API and the ASA committees concerned.

Ball and Roller Bearings (B3)

Scope: Boundary dimensions of ball and roller bearings for radial and thrust loads or combinations thereof, as affecting the interchange or replacement of such bearings in machinery; and the tolerances on such dimensions.

Sponsors: Society of Automotive Engineers and American Society of Mechanical Engineers.

Three standards, so far approved by the ASA, have been published in a single pamphlet.

The American Standard, Annular Ball Bearings —Single Row Type and Separable (Open) Type (B3.1-1933), gives tables for single-row type bearings of the light, medium, and heavy series (up to Nos. 264, 356, and 448, respectively). This standard for single-row bearings is in practical accord with those of other national standardizing bodies, so that international interchangeability has been secured here. This standard also covers separable (open) type bearings (up to No. 19). The American Recommended Practice, Annular Ball and Roller Bearings, Wide Type (B3.2-1930), lists bearings in the light, medium, and heavy series—the former two series with extensions to Nos. 5264 and 5356, inclusive, and the heavy series, up to No. 5420. This standard was developed upon request of the National Electrical Manufacturers Association. The American Standard, Angular Contact Ball Bearings (B3.3-1933), covers bearings in the light, medium, and heavy series, up to Nos. 7222, 7322, and 7418, respectively.

Allowances and Tolerances for Cylindrical Parts, and Limit Gages (B4)

Scope: Nomenclature and classification of fits between cylindrical parts, including allowances and tolerances for interchangeable manufacture; classification and fixing of standard tolerances for plain limit gages.

Sponsor: American Society of Mechanical Engineers.

In 1925, the American Tentative Standard,

Courtesy Pratt & Whitney Co.

Gage accuracy is the basis of mass production

Tolerances, Allowances and Gages for Metal Fits (B4a-1925), was approved by the ASA. While it has given satisfaction in a number of practical applications—for example, in the machine tool industry—it has also been criticized for the following reasons: (1) The standard covers only the Basic Hole System. (2) It gives only eight classes of fit and only one grade of shaft in each class. (3) The range of nominal diameters has too many subdivisions.

A revision was started in 1930 and is still pending.

The ASA committee has paid considerable attention to the ISA System of Fits developed by a technical committee of the International Standards Association (ISA) of which the ASA is a member. The ASME is preparing a presentation of the ISA System of Fits for the information of ASA committee B4. This report is expected to become available soon. Meanwhile, details about the ISA System can be supplied by the ASA office.

Before the present war broke out, the ISA System had already been adopted, formally or in principle, by 16 European countries. (See also the article, Tolerances for Cylindrical Fits, published serially in INDUSTRIAL STANDARDIZATION, January to April, 1941, and now available from the ASA in pamphlet form.)

Small Tools and Machine Tool Elements (B5)

Scope: The standardization of the elements of machine tool construction and operation, and of tool and work holding elements and associated appurtenances, including driving mechanisms that constitute an inherent part of the machine tool; and relating primarily to the use of machine tools on manufacturing operations in mechanical industry; sizes, capacities and clearances of machine tools and of other work and tool holding parts; length of stroke, travel and other movements and adjustments; parts and elements for holding and adjusting, guiding or aligning work or tools, including bolts and nuts, slots, bushings and tapers; drills, taps, reamers, cutters, countersinks, chucks, jigs, etc.

Sponsors: American Society of Mechanical Engineers, Society of Automotive Engineers, and National Machine Tool Builders Association.

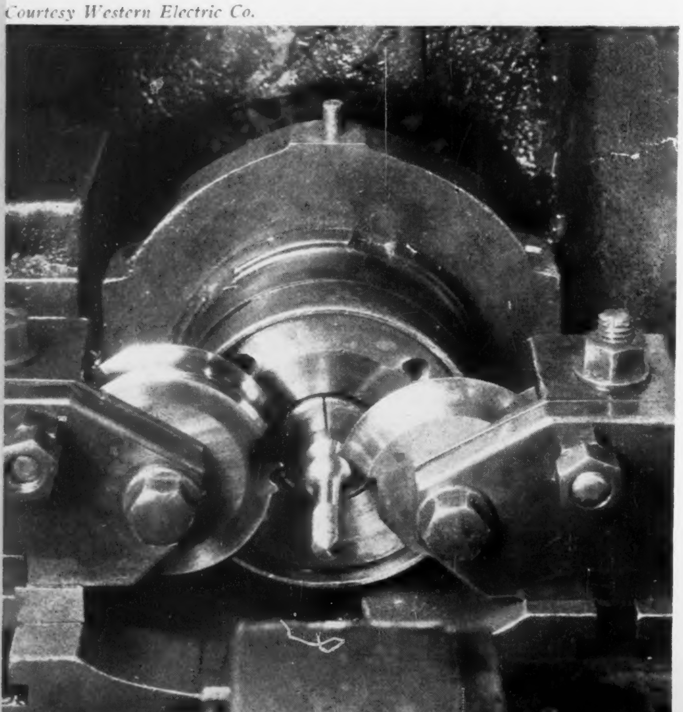
With a view to the wide field covered by this project, committee B5 is divided into some 20 technical committees, each having its own chairman and secretary. The work of each Technical Committee will be reviewed here.

T-Slots (Technical Committee 1)—An American Tentative Standard, T-Slots, Their Bolts, Nuts, Tongues and Cutters, approved in 1927, recently became an American Standard (B5.1-1941). The only revision was that the minus tolerance of 0.001 in. on the width of throat was changed to a plus tolerance of the same amount.

Tool Posts and Tool Shanks (Technical Committee 2)—The American Standard, Tool Holder Shanks and Tool Post Openings (B5b-1929) is still in force, but a revision is under consideration. The shank section, lathe opening, planer and shaper opening, lathe center height, and lip height is listed for tools from Nos. 00 to 11, inclusive.

Circular forming and cutting tools at work

Courtesy Western Electric Co.



Machine Tapers (Technical Committee 3)—Some 20 years ago, numerous different self-holding ("slow") machine tapers were used in workshops. A survey is said to have listed close to 200 varieties. The systems mainly used were the Brown and Sharpe, the Morse, and the Jarno series.

After many long discussions, it was decided to set up 19 American Standard machine taper sizes divided into three groups: (1) three Brown and Sharpe tapers; (2) six Morse tapers; and (3) ten ¾ in.-per-foot tapers. This standard was approved by the ASA under the title Machine Tapers, Self-Holding Series (B5.10-1937). It also gives tables for different tongue and key drives of the shank, and for plug and ring gages for checking the sockets and the shanks.

In a revision of this standard, completed but not yet submitted to the ASA for approval, the most important changes and additions are: (1) changes in the tolerances on some auxiliary parts, such as keys and keyways; (2) the addition of some dimensions of the shank and driving keys; (3) the addition of the Morse tapers Nos. 6 and 7 and the ¾ in.-per-foot taper No. 450; and (4) the addition of a series of steep (self-releasing) tapers, with a slope of 3½ in. to the foot, on diameter.

Steep tapers of this series have been used since 1927 on the milling machine spindle ends and arbors adopted as standard by the National Machine Tool Builders' Association.[2]

Spindle Noses and Collets for Machine Tools (Technical Committee 4)—The American Standard, Lathe Spindle Noses for Turret Lathes and Automatic Lathes (B5.9-1936), is an example of a standard being developed on the basis of new engineering design specially undertaken for the purpose, instead of being selected from existing designs. In these spindle noses, a taper pilot is used for centralizing chucks or face plates, and a large flat face is used for locating endwise. A press fit on the taper pilot is used when locating against the flat face. The American Standdard gives specifications for four types of spindle noses (A, B, C, D), each in seven different sizes (4 to 20 in.), including dimensions of the spindle noses; location of holes and driving buttons; dimensions of chucks, face plates, and other parts; and the gages required for checking the several components. The counterpart of this standard is the American Standard, Chucks and Chuck Jaws (B5.8-1936), see p 325.

[2] The further details of the NMTBA designs for milling machine spindle ends and arbors have not yet been dealt with under ASA procedure. However, recently there have been indications that these designs may be submitted for ASA approval at an early date.

Milling Cutters (Technical Committee 5)—Approved in 1930, the American Standard, Milling Cutters: Nomenclature, Diameters, Thickness and Other Important Dimensions (B5c-1930), is still unrevised. It contains a classification of milling cutters on three bases: relief of teeth, method of mounting, and "hand of rotation"; definitions of cutter types; dimensional tables for 15 different types of cutters other than gear cutters; involute gear cutters; cutters for fluting taps and reamers; concave, convex and corner-rounding cutters; sprocket-wheel cutters for roller chains; and keyseat, keyway and key dimensions for cutters and arbors.

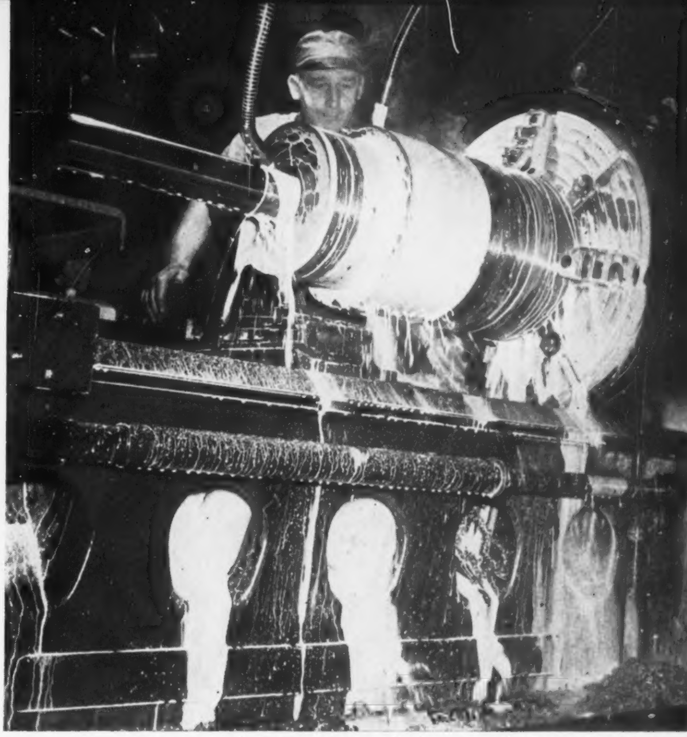
Designations and Working Ranges of Machine Tools (Technical Committee 6)—The draft of a proposed American Standard for Designations and Working Ranges of Surface Grinders of the Reciprocating Table Type, based on the standard developed by the Surface Grinders' Group of the National Machine Tool Builders' Association has been under consideration by this Technical Committee for some time.

Twist Drills (Technical Committee 7)—The American Standard, Twist Drills, Straight Shank (B5.12-1940), gives a preferred series of 116 drill diameters, from .0156 to .5000 in., inclusive. These have been selected from 274 commercial sizes and include a sufficient number of tap drill sizes to provide suitable percentages of thread depth in tapped holes for American Standard coarse and fine threads. Each drill is designated by its nominal diameter expressed in a decimal fraction of the inch, instead of by a number, letter, binary fraction, or millimeter size. The standard also gives the overall length and flute length of the drills, a regular and a long series being listed for drills with a diameter of .1250 in. upward. A section on Terminology and Definitions precedes the tables.

Jig Bushings (Technical Committee 8)—The American Standard, Jig Bushings, approved first in 1935 and revised in 1941, as B5.6-1941, gives dimensional tables for three types of bushings: (1) Press-fit wearing bushings (headless and head types); (2) Renewable wearing bushings (slip and fixed types); and (3) Liner bushings (headless and head types). In each series, the subrange of the largest hole sizes covered is from 1.3906 to 1.7500 in., inclusive.

Punch Press Tools (Technical Committee 9)—The draft of a proposed American Standard for Punch and Die Sets is being prepared by this Technical Committee.

Forming Tools and Holders (Technical Committee 10)—The American Standard, Circular and Dovetail Forming Tool Blanks (B5.7-1936), covers sizes and types of such blanks for six dif-



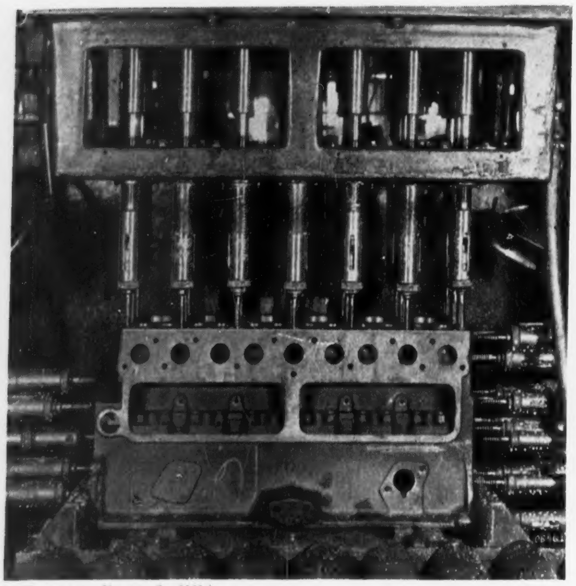
Courtesy Warner & Swasey and Mechanical Engineer

Turning a 1,030 lb forging machine pinion on a turret lathe

ferent groups of automatic screw machines comprising altogether more than 80 machines. The machine groups are numbered 1 to 6. The circular tools for groups 1 to 3 have threaded holes and those for groups 4 to 6, countersunk holes. An inserted sheet, dated April 1938, contains the correction of two errors and two additions suggested by the chairman of Technical Committee 10, all of which are meant to be incorporated in the first revision.

Chucks and Chuck Jaws (Technical Committee 11)—Two American Standards have been completed by this Technical Committee, one for Rotating Air Cylinders and Adapters (B5.5-1932), and the other for Chucks and Chuck Jaws for Turret Lathes and Automatic Lathes (B5.9-1936). The former was developed to obtain interchangeability of different makes of air cylinders on the spindles of machine tools without changing the adapter or draw-rod. Three sizes of standard adapters cover the range of air cylinders from 3 to 18 in., inclusive. A fourth size is included to take care of a 20-inch air cylinder with a drawrod pull of 26,000 to 40,000 pounds.

The standard for Chucks and Chuck Jaws supplements the standard for Lathe Spindle Noses (see Technical Committee 4). Like the latter, it has been developed on the basis of new designs developed through cooperation of members of the ASA technical committee. The standard lists 11 sizes of standard chucks (from 6 to 36 in.) which was deemed the smallest number that would cover the requirements of machine tools in common use. Three classes of chucks have been



Courtesy Pratt & Whitney

Multiple tapping machine showing nearly 40 hand taps operating at the same time

established, as follows: Class 1, medium duty chucks for engine lathes and other turning machines where the service is not severe and chucks must be handled frequently; Class 2, Chucks of the heavy duty tongue-and-groove jaw type, for turret lathes and other machines where heavy grip is required; and Class 3, Chucks of the heavy-duty serrated type for turret lathes requiring the utmost in holding means.

Cut and Ground Thread Taps (Technical Committee 12)—The American Standard, Cut and Ground Thread Taps (B5.4-1939), is the first revision of the 1930 edition. It contains sections on Tap Terminology and Definitions; Screw Thread Terms and Definitions; and Marking of Taps. Tables give the thread and general dimensions, with working tolerances, for the following types of taps: Hand taps, machine screw taps, tapper taps, nut taps, pulley taps, boiler taps, mud or washout taps, staybolt taps, pipe taps, and combined pipe tap and drill.

Splines and Splined Shafts (Technical Committee 13)—When this Technical Committee started its work, in 1930, it considered setting up a standard for straight splines. However, under the influence of the changing trend in industry, an American Standard for Involute Splines, Side Bearing (B5.15-1939) was developed. This covers five series of 30-degree involute splines with 6, 10, 16, 24, and 36 teeth, respectively, for the fitting (internal spline) and the shaft (external spline). Three depths (shallow, intermediate, and deep) are given in each series. The size of each spline is designated by the symbol for the corresponding bore of a ball or roller bearing. The total size range is from No. 04 (20 mm, or about 3/4 in.) to No. 22 (110 mm, or about 4 3/8 in). The Appendix gives tables for the measurement of the splines and dimensions of the hobs required to cut them, illustrated by diagrams.

Multiple Spindle Drilling Heads (Technical Committee 18)—The American Standard, Adjustable Adapters for Multiple Spindle Drilling Heads (B5.11-1937), applies to adapters for securing vertical adjustment for taper shank tools when used with multiple spindle drilling heads. It contains tables for the general dimensions of assembly, detailed dimensions of the adapter body, and general dimensions for adapter nuts.

Technical Committee 18 was disbanded in 1939.

Single-Point Cutting Tools (Technical Committee 19)—It was deemed necessary to set up the American Standard, Terminology and Definitions for Single-Point Cutting Tools for Lathes, Planers, Shapers, Turret Lathes, Boring Mills, etc. (B5.13-1939), before starting work on the standardization of single-point cutting tools themselves. For example, there was no uniform practice in the use of the terms "right hand" or "left hand" tool. This often led to confusion which can now be avoided by using the terms "right cut" and "left cut" tool, as defined in the standard. Similarly, controversies concerning certain terms for tool angles and working angles, such as "relief" and "clearance", have been removed by the standard definitions. Symbols for single-point cutting tools, to be used in catalogs, purchase orders, etc., are also given.

Reamers (Technical Committee 20)—The American Standard, Reamers (B5.14-1941), contains 30 tables for the dimensions and tolerances for various types of hand, machine (jobbers), shell, chucking, stub screw machine, Morse taper, taper pin, die maker's, taper bridge, taper car, taper pipe, and center reamers; machine countersinks; and arbors for shell reamers. The tables give for each reamer the length overall, length of flute, and the range of the number of flutes (for example, 4 to 6), together with details governing the connection with the driving member, such as the dimensions of the square, or the number of the taper shank.

Tool Life Tests for Single-Point Tools (Technical Committee 21)—This Technical Committee was appointed in 1939 following a request from industry that methods of testing single-point tools be standardized so that test results would

be comparable. Factors involved are, for example, the shape and size of the tool, the characteristics of the tool material and the material being cut, the speed and feed used in cutting, etc. Two subcommittees were appointed, one to deal with high-speed steel tool tests, and the other with carbide-tipped tool tests. The work is still in the committee stage.

Accuracy of Engine Lathes (B5.16-1941)—This standard was developed by the Engine Lathe Group of the National Machine Tool Builders' Association and adopted in 1940 by the NMTBA as an Association standard. Since it proved to be valuable in procuring machine tools for the defense program, the NMTBA submitted the standard to the ASA, which approved it, under special rules then recently adopted, as one of the first American Defense Emergency Standards. It provides a series of 25 tests to be applied in checking engine lathes for accuracy. These include tests for bed level, tailstock way alignment, spindle center runout, cam action, lead screw alignment, turning work round or cylindrical when mounted in chuck or between centers, etc. The accuracy requirements, stated in terms of maximum permissible variations, apply to three groups of engine lathes: toolroom lathes; engine lathes, 12 to 18 in., inclusive; and engine lathes, 20 to 36 in., inclusive.

Gears (B6)

Scope: Standardization of spur, helical, herringbone, bevel, and worm gearing, covering general gear proportions; tooth form; mounting of gears; selection of materials; inspection of gears; nomenclature.

Sponsors: American Gear Manufacturers Association and American Society of Mechanical Engineers.

The American Standard, Spur Gear Tooth Form (B6.1-1932), covers the $14\frac{1}{2}$ degree composite system, the $14\frac{1}{2}$ degree full depth involute system, and the 20 degree involute system (full depth and stub).

The American Recommended Practice, Gear Materials and Blanks (B6.2-1933), gives specifications for four groups of materials: Forged and Rolled Carbon Steel; Steel Castings; Bronze and Brass Castings; and Forged and Rolled Alloy Steel. The steels are intended for three groups of gears, classed according to heat treatment: (*a*) case-hardened gears; (*b*) unhardened gears, not heat-treated after machining; and (*c*) hardened and tempered gears.

The third American Standard in this field so far approved is Backlash for General Purpose Spur Gearing (B6.3-1940). It lists the minimum, average, and maximum thickness of the feeler for checking backlash, for diametral pitches from 1 to 24, inclusive.

A fourth standard, Keyways for Holes in Gears, has been completed and submitted to the ASA for approval. By decision of the ASA Mechanical Standards Committee, ASA action is waiting for the clarification of some details.

Pipe Flanges and Fittings (B16)

Scope: Standardization of dimensions, designation of materials and the pressure-temperature rating of (1) pipe flanges; (2) pipe fittings (screwed, flanged and welding), including bolting, for pipes carrying steam, gas, air, water, oil, ammonia, etc.; (3) other types of fittings attached to pipe; and (4) standardization of face-to-face dimensions of ferrous gate, globe, angle and check valves.

Sponsors: American Society of Mechanical Engineers; Manufacturers Standardization Society of the Valve and Fittings Industry; and Heating, Piping and Air Conditioning Contractors National Association.

Eleven American Standards developed by committee B16 have so far been approved by the ASA. They concern cast-iron flanges and fittings, malleable iron fittings, steel flanges and fittings, pipe plugs, and face-to-face dimensions of ferrous flanges and welding-end valves.

Set-up of B16 Standards

All of the standards for flanges and fittings have been set up in a similar way, as follows: The main body of information, consisting of a series of dimensional tables, is preceded by Introductory Notes containing sections on such matters as pressure rating; size designation and marking of flanges and fittings; metal thickness and the tolerance thereon; flange facings; bolting specications for flanges (arrangement and size of bolts; materials for bolts and nuts; kind of thread, etc.); threading specifications for screwed flanges and fittings; spot facing; information concerning special types of fittings, such as reducing fittings, elbows, crosses, etc.; specifications for drain tappings, and the like. The Introductory Notes form an integral part of each standard and, therefore, should be consulted in detail. However, for the sake of simplicity, only a brief reference to them will be made in the following review of the individual B16 standards.

Review of B16 Standards

The American Standard, Cast-Iron Pipe Flanges and Flanged Fittings, Class 125 (B16a-1939) is the first revision of a standard approved in 1928. In this revision, the pressure ratings of all flanges and fittings in sizes 6 in. and larger were reduced. Therefore, the term "Class 125" was adopted instead of the term "maximum WSP of 125 lb per sq in." used in the 1928 edition. The Introductory Notes (see above under "Setup of B16 Standards") are followed by diagrams showing the methods of designating outlets of reducing fittings in specifications, and the location of tapped holes for drains. The main contents of the standard consist of dimensional tables for

American Standards in the mechanical field not only take care of the proper assembly and operation of the physical units of our industrial machinery—in a wider sense they also make possible the proper coordination and unification of our national defense machinery.

—Alfred Iddles
Chairman, ASA Mechanical Standards Committee.

cast-iron flanges, drilling arrangement for bolts, and bolt lengths; screwed companion and blind flanges; elbows, tees and crosses (straight size); reducing tees and crosses (short body form); laterals (straight sizes); reducers; true Y's; double branch elbows; reducing laterals (short body pattern); base elbows and base tees; anchorage bases for tees (straight sizes), and reducing tees (short body pattern). An appendix gives, for information only, tables of theoretical weights of Class 125 Fittings.

The American Standard, Cast Iron Pipe Flanges and Flanged Fittings, for Maximum Working Saturated Steam Pressures of 250 lb per sq in. (Gage) (B16b1-1928), is arranged along lines similar to B16a-1928. In 1940, a revision of this standard was completed by committee B16. This proposal is still pending due to the desire of the valve and fitting manufacturers' group to make a further investigation of certain pressure rating questions.

In the American Standard, Cast Iron Pipe Flanges and Flanged Fittings for Maximum Non-Shock Working Hydraulic Pressure of 800 lb per sq in. (Gage) at Ordinary Air Temperatures (B16b1-1931) the Introductory Notes (see above, under "Setup of B16 Standards") are followed by tables for the facing dimensions of the flanges and the center-to-contact surface, and center-to-flange-edge dimensions of the fittings, for the nominal pipe size range from 2 to 12 in. The use of cast-iron laterals for hydraulics work is discouraged; instead, 600 lb steel flanged laterals (as given in B16e-1939) are recommended.

The American Tentative Standard, Cast Iron Pipe Flanges and Flanged Fittings for Maximum Working Saturated Steam Pressure of 25 lb per sq in. (Gage) (B16b2-1931) is intended also to be used for a maximum gas working pressure of 25 pounds. Furthermore, fittings according to this standard, in nominal sizes 36 in. and smaller, may be used for a maximum non-shock working hydraulic pressure of 43 lb per sq in. (Gage), at or near the ordinary range of air temperatures. The standard gives dimensional tables for flange drilling; elbows; tees and crosses (straight sizes); reducing tees and crosses (short body patterns); and theoretical weights of elbows, tees, and crosses. The Introductory Notes contain information of the kind referred to under "Set-up of B16 Standards."

The American Standard, Cast Iron Long Turn Sprinkler Fittings (Screwed and Flanged) (B16g-1929), gives dimensional tables for elbows, base elbows, tees and crosses, and their connection by flange or threaded band. These data are given for two maximum hydraulic working pressures. One was originally 150 lb per sq in. but since the fittings concerned appeared to be amply heavy for a service pressure of 175 lb per sq in., the latter value was adopted in the Addendum B16g1-1937, approved as a revision of B16g-1929. As to the Introductory Notes, see above, under "Set-up of B16 Standards."

The American Standard, Malleable Iron Screwed Fittings, 150 lb, (B16c-1939), gives dimensional tables for elbows, tees, crosses, and 45-degree elbows (straight sizes); elbows, crosses and tees (reducing sizes); 45-degree Y-branches (straight sizes); service or street tees and 90-degree and 45-degree elbows (straight sizes); couplings (straight and reducing sizes); caps; return bends (close, medium and open patterns); locknuts; and pipe bushings (face, outside hexagon and inside hexagon). An Appendix gives tables for Pipe Plugs, reproduced from B16e2-1936 (see later); and welded and seamless steel pipe, reproduced from B36.10-1939 (see later). For the type of information included in the Introductory Notes, see "Set-up of B16 Standards" above.

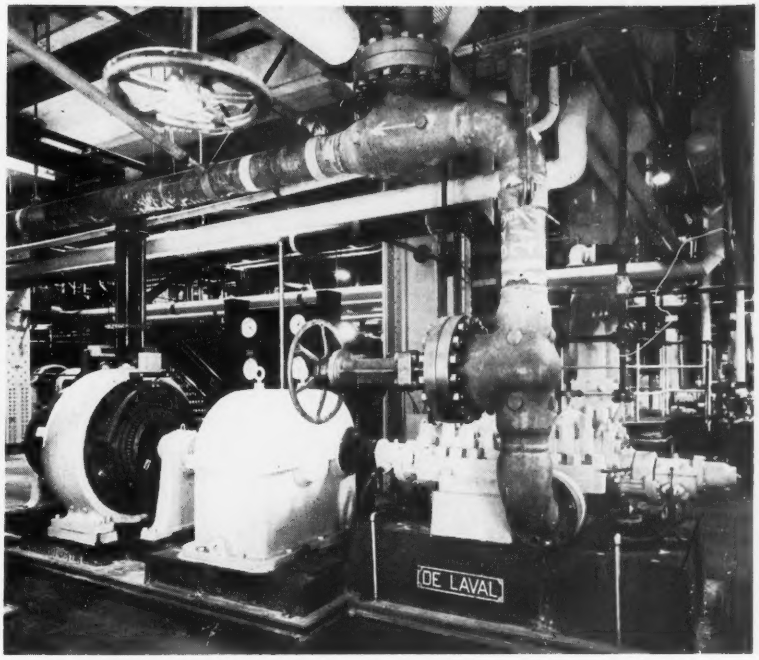
The American Standard, Cast Iron Screwed Fittings, 125 and 250 lb (B16d-1941), is the first revision of a standard approved by the ASA in 1927. The Introductory Notes (see above, under "Set-up of B16 Standards") are followed by dimensional tables for 125 lb fittings comprising 90- and 45-degree elbows, tees and crosses (straight sizes); reducing elbows, crosses, tees and couplings; caps; and close and open pattern return bends; and one table for 250 lb fittings comprising 90- and 45-degree elbows, tees and crosses (straight sizes). An Appendix gives a table of Pipe Bushings reprinted from American Standard B16c-1939, discussed earlier in this review.

The American Standard, Steel Pipe Flanges and Fittings, was approved first in 1927, and was revised in 1932 and again in 1939. The second revision, B16e-1939, was slightly corrected and

High-pressure piping at discharge of 1000 to 1200 psi boiler-feed pump in large central station

The factory-made welding ell corresponds to Schedule 80 fittings in the American Standard B16.9-1940

Courtesy Detroit Edison Co.



supplemented in 1940 by an Addendum, B16e4-1940, approved by the ASA. In the latest edition of the standard, this Addendum is bound together with pamphlet B16e-1939. This covers steel flanges and flanged fittings for primary service pressure ratings of 150, 300, 400, 600, 900, 1500, and 2500 lb per sq in. (Gage) and contains tables of the physical and chemical requirements of materials for flanges and fittings, alloy-steel bolting material, and carbon-steel nut material; tables of service pressure ratings, up to certain temperature limits, for the different kinds of flanges and flanged fittings (of different materials, and with "standard" or ring-joint facings), for water, steam or oil; diagrams indicating the method of designating outlets of reducing fittings and the location of tapped holes for drains; sketches of typical flange facings; tables of the facing dimensions for the flanges for all pressure ratings from 150 to 2500 lb per sq in., inclusive; tables of the dimensions of screwed, lapped, blind, welding-neck, and reducing screwed flanges, for all ratings, and slip-on welding flanges for the ratings 150 and 300 lb per sq in.; tables of dimensions for flanges, fittings, and flanges with ring-joint, for all ratings; designating symbols for ring-joint gaskets and grooves; and lengths of alloy-steel studs. For the user's convenience, an Appendix gives a table of dimensions of welded and seamless steel pipe (nominal wall thicknesses for different Schedule Numbers) reprinted from the American Standard, Wrought-Iron and Wrought-Steel Pipe (B36.10-1935), discussed on p. 334. For Introductory Notes, see "Set-up of B16 Standards" above. Preparations for a new revision of this standard have begun.

The American Standard, Pipe Plugs (B16e2-1936), contains dimensional tables for three types of pipe plugs: square-head pattern (range: 1/8 to 3 1/2 in.), bar or slotted pattern (range: 4 to 12 in.), and countersunk pattern (range: 1/2 to 6 in.), all types to be made of cast iron, malleable iron, cast steel or forged steel. Square-head plugs are used, not only with pipe fittings, but also in large quantities by the automobile industry and other builders of machinery. Therefore, the square heads are made to conform to open-end wrenches. For the same reason, the square sockets of the countersunk-pattern plugs are made to the maximum permissible sizes of the corresponding commercial hot-rolled steel bars.

The American Standard, Steel Butt-Welding Fittings (B16.9-1940), covers wrought and cast carbon-steel and alloy-steel welding fittings, wrought-steel fittings to be made of pipe, tubing, plate or forgings. The pressure and temperature ratings of these welding fittings shall be based on the maximum stresses permitted in the Code for Pressure Piping (B31.1-1935) (discussed on p. 333) for pipe of the same or equivalent material. The dimensional tables cover butt-welding elbows (90 and 45 degree), tees, caps; lapped-joint stub ends, reducers, and 180-degree

return bends. The Introductory Notes, in addition to the usual data (see "Set-up of B16 Standards"), specify a hydrostatic test, tolerances on the dimensions of the several types of fittings, and details of the welding bevel.

The American Standard, Face-to-Face Dimensions of Ferrous Flanged and Welding-End Valves (B16.10-1939), was set up, among other things, to secure interchangeability in a pipe line between wedge-gate and double-disc gate valves of a given rating and flange dimension. It contains tables for cast-iron and steel flanged wedge-gate valves, globe and angle valves, and flanged swing check valves; cast-iron double-disc flanged gate valves; and steel wedge-gate, globe, angle and check valves with ring joints. Another table lists the approximate distance between the ends of a steel valve with ring flanges when the rings are compressed. The Introductory Notes (see "Set-up of B16 Standards") contain a section explaining the agreement between the American Standards and others adopted by the Manufacturers' Standardization Society of the Valve and Fittings Industry and the American Petroleum Institute. Sketches of different types of connecting end flanges are given and the specifications for the welding bevel are reprinted in the Appendix from B16e-1939 (discussed on p 328).

New B16 Standards Under Development

Two draft standards were recently distributed to industry for criticism and comment. One is a proposed American Standard for Steel Socket-Welding Fittings, covering overall dimensions, tolerances, materials, and marking of wrought and cast carbon and alloy-steel welding fittings. The other is a proposed American Standard, Cast-Iron Screwed Drainage Fittings, designed primarily for drainage systems using "Schedule 40" screw piping. (For the meaning of Schedule Numbers for pipe, see Wrought-Iron and Wrought-Steel Piping (B36), p. 334). It covers dimensions of threaded ends for nominal pipe sizes from $1\frac{1}{4}$ to 6 in., inclusive, dimensions of different types of drainage fittings, and material specifications.

Shafting (B17)

Scope: Diameters of transmission and machinery shafting and tolerances on shafting stock; choice and proportions of shafting keys and tolerances on key stock; development of standard formulas and procedure to be used in determining transmission and shafting sizes.

Sponsor: American Society of Mechanical Engineers.

Four American Standards approved in 1924, 1925, and 1927 were merged later into the American Standard, Shafting and Stock Keys (B17.1-1934). This gives tables for the diameters and tolerances of commercial-stock finished transmission and machinery shafting; square and flat plain parallel stock keys; plain taper stock keys; and gib-head taper stock keys. (All types of keys are given in the square and flat types.) The establishment of a standard specification for the straightness of shafting is now under consideration.

The American Standard, Woodruff Keys, Keyslots and Cutters (B17f-1930), contains dimensional tables for keys from 1/16 x $\frac{1}{2}$ to $\frac{3}{8}$ x $1\frac{1}{2}$ in. (width x length), the corresponding keyslots, and the cutters for producing the latter. Index numbers have been adopted to indicate the nominal dimensions of each key and cutter. No material specifications are given, nor any recommendation as to what key should be used for a given shaft. This is left to the judgment of the designer.

The American Tentative Standard, Code for Design of Transmission Shafting (B17c-1927), covers (*a*) designing formulas for the cases most frequently met in the design of transmission shafting; and (*b*) diagrams for use in designing shafting. There are two Appendices. Appendix A covers the various stress conditions that may be set up in a transmission shaft; the various theories of elastic failure evolved that have led to the many formulas found in engineering literature; the application and limitation of the various theories of elastic failure as applied to ductile ferrous material used in shafts, and the elastic shearing strength of ductile ferrous materials. Appendix B covers designing stresses, shafting steels, effect of straining action upon working stresses, and the use of constant or base stress with shock and fatigue factors. The formulas given in the standard take into account strength, but not rigidity or deformation of a shafting system.

Bolt, Nut and Rivet Proportions (B18)

Scope: Standardization of dimensions, material and nomenclature of rivets, hexagonal and square head bolts and nuts, slotted head bolts and machine screws: track bolts, carriage bolts and special bolts and nuts for agricultural machinery; but not including the standardization of screw threads.

Sponsors: American Society of Mechanical Engineers and Society of Automotive Engineers.

The American Standard, Small Rivets (B18a-1927), contains dimensional tables for eight rivets, with nominal diameters from 3/32 in. to 7/16 in., inclusive, with flat, countersunk, button, pan, and truss or wagon heads. Tolerances are specified for the shank diameters, but not for the head dimensions. Nor is the overall length (length under the head to end) standardized; this will be made to order. The steel to be used for the rivets is specified in the Introductory Notes. However, objections to the requirements specified for this steel have been raised and a

proposal for its revision has been submitted by the rivet manufacturers.

The American Standard, Socket Set Screws and Socket-Head Cap Screws (B18.3-1936), is solely dimensional. It covers hexagonal and fluted socket set screws, in sizes from No. 5 to 2 in.; hexagonal and fluted socket cap screws, in sizes from No. 8 to $1\frac{1}{2}$ in.; and wrenches to go with either type of head, hexagonal or fluted. For socket set screws, six different kinds of points are specified, as follows: cup, oval, flat, cone, full dog, and half dog. The screw threads are to conform with the American Standard (B1.1-1935) (see p 322).

The American Standard, Large Rivets (B18.4-1937), covers rivets with diameters from $\frac{1}{2}$ to $1\frac{3}{4}$ in., inclusive, and the following manufactured shapes of head: button; high button (acorn); cone; flat-top countersunk; round-top countersunk; and pan. For the head types other than the countersunk, the standard also gives the dimensions of the manufactured head after driving and the driven head, and the hold-on (dolly bar) and rivet set impressions. While the rivets mentioned are ordinarily supplied with straight necks, the standard also gives a table for swell-neck dimensions applicable to all types of heads, except the countersunk. Tolerances are given on body diameter, head dimensions, and diameter of swell-neck. Materials are specified by reference to ASTM specifications. Among the problems which had to be solved before this standard could be set up were those concerning tolerances on body diameters and the shape of the acorn head. The former required extensive correspondence with the ASTM and with the ASME Boiler Code Committee, and the latter required a considerable amount of research and experimentation.

The American Standard, Wrench-Head Bolts and Nuts and Wrench Openings (B18.2-1941), is the second revision of the original standard approved in 1927. It contains tables for the nominal dimensions and tolerances for regular, heavy, and light series of bolt heads, nuts, and jam nuts, covering square and hexagon, unfinished and semi-finished products; cap screw and set screw heads; regular, heavy, and light slotted nuts; light thick, and light thick slotted nuts; light castle nuts; and machine screw and stove bolt nuts. A table of wrench openings from 5/32 to $6\frac{1}{8}$ in. lists the applications of each size, the corresponding allowance (minimum clearance between bolt head or nut, and wrench jaws) and the limits of the wrench opening. By way of information, but not as part of the standard, an Appendix recommends minimum thread lengths for bolts.

The American Standard, Slotted Head Proportions (B18c-1930), covers the dimensions of flat, round, fillister, and oval heads as used for ma-

Courtesy Bethlehem Steel Corp

Caulking large rivets

chine screws (nominal sizes from No. 2 to $\frac{3}{8}$ in.), cap screws (nominal sizes from $\frac{1}{4}$ to $\frac{3}{4}$ in. for flat and button heads, and to 1 in., for fillister heads), and wood screws (nominal sizes from No. 0 to 24). (For cap screws, the round head is called "button head".) Also, tables are given for the preferred lengths and head types for machine screws (with American Standard coarse or fine thread) of each nominal size covered by the standard; for the preferred lengths and head types for machine screws of each nominal size covered by the standard; and the "standard" screw lengths and heads of brass and steel wood screws. Specifications for the screw lengths, thread lengths, and points of cap screws are given with the tables for the latter.

The American Standard, Track Bolts and Nuts (B18d-1930), developed on the basis of a study of the types of bolt used by the railroads in the United States and Canada, lists the dimensions of seven nominal sizes of oval-neck track bolts, stepping up by $\frac{1}{8}$ in., from $\frac{1}{2}$ to $1\frac{1}{4}$ in. The six intermediate "16th" sizes of oval-neck track bolts and seven elliptic-neck track bolts in sizes from $\frac{3}{4}$ to $1\frac{1}{4}$ in. are listed as *special* sizes, to be used during the transition period from existing to American Standard practice. Similarly, the dimensions of track bolt nuts (square, hexagon and recessed) are listed in the "8th" sizes from $\frac{1}{2}$ to

$1\frac{1}{4}$ in., with the intermediate "16th" sizes as *special* sizes.

No material specifications for track bolts and nuts are given in the standard, but reference is made to three ASTM specifications for track bolts. Screw thread of American Standard form (according to B1.1-1935) or Harvey Grip thread is to be used for track bolts, according to this standard.

The American Standard, Plow Bolts (B18f-1928), was developed by a subcommittee of committee B18, in cooperation with a committee of the National Association of Farm Equipment Manufacturers. A survey revealed the existence of seven types of bolts, representing 182 varieties. Four types, representing 42 varieties, were selected as standard. They are (1) the round-head, square-neck, type; (2) the square-head type; (3) the round-head, heavy-key type; and (4) the round-head, reverse key type (all heads countersunk). These types, corresponding to the old NAFEM types Nos. 3, 4, 6, and 7, respectively, are listed together with the corresponding repair bolts. American Standard coarse thread, class 2 fit, is specified (see B1.1-1935) and tables of bolt and thread lengths are included as a guide to the user of plow bolts.

The American Standard, Tinners', Coopers' and Belt Rivets (B18g-1929), was first approved as an American Tentative Standard in 1928. Tinners' rivets are listed from the 8-ounce size (.089 in.) to the 16-ounce size (.300 in.); coopers' rivets from the 1-lb size (.109 in.) to the 16-lb size (.281 in.), and belt rivets from size No. 7 (.180 in.) to No. 13 (.095 in.). For all types, tolerances are given on the body diameter, but not on the head dimensions. Specifications for the composition and physical properties of the steel to be used for the three kinds of rivets are given in the Introductory Notes.

Fire Hose Coupling Screw Thread (B26)

Scope: The threaded parts of fire-hose couplings, hydrant outlets, stand-pipe connections, Siamese connections, and all other special fittings on fire lines where fittings of $2\frac{1}{2}$, 3, $3\frac{1}{2}$ and $4\frac{1}{2}$ inches nominal diameter are used.

Sponsors: American Society of Mechanical Engineers, American Water Works Association, and National Board of Fire Underwriters.

The American Standard, Fire Hose Coupling Thread (B26-1924), covers the threaded parts of fire-hose couplings, hydrant outlets, standpipe connections, Siamese connections, etc., with nominal inside diameters of $2\frac{1}{2}$, 3, $3\frac{1}{2}$ and $4\frac{1}{2}$ in. It also covers the limiting dimensions of the field inspection gages. Product made to the limiting dimensions specified by the American Standard is interchangeable with that made to the specifications published by the National Fire Protection Association in 1907, by the National Board of Fire Underwriters in 1911, by the ASME in 1913, and by the National Bureau of Standards in 1914 and 1917. At the end of 1939, 5741 municipalities in the United States had changed over to the American Standard, not counting those whose threads had been in agreement with this standard before it was approved by the ASA. In several states, such as California, Oregon, and Texas, use of the American Standard has become mandatory.

Plain and Lock Washers (B27)

Scope: Cast iron and malleable iron plain washers, and steel lock and plain washers.

Sponsors: American Society of Mechanical Engineers and Society of Automotive Engineers.

A draft of a proposed American Standard for Plain Washers, distributed to industry for criticism and comment in 1936, appeared not to be acceptable to the representatives of the manufacturers on committee B27. The sponsor bodies, which found the proposal to be satisfactory to them, have tried to break the deadlock, so far without success.

A draft of a proposed American Standard for Lock Washers was distributed for criticism and comment in 1931. This proposal appeared to be unsatisfactory to the automotive industry. Recently, a new subcommittee on Spring Washers has taken up this matter actively again on the basis of recommendations made informally by a group of automotive engineers and lock washer manufacturers.

Transmission Chains and Sprockets (B29)

Scope: Formulation of American standards for transmission roller chains and sprocket teeth, based on the standards already adopted by the Society of Automotive Engineers, the American Society of Mechanical Engineers, and the American Gear Manufacturers Association; and the study of the possibilities of standardizing the so-called silent type of transmission chains and sprockets towards establishing standards for them.

Sponsors: American Society of Mechanical Engineers, Society of Automotive Engineers, and American Gear Manufacturers Association.

The American Standard, Roller Chains, Sprockets and Cutters (B29a-1930), concerns the products commonly used for the transmission of power in industrial machinery; machine tools; motor truck, motorcycle, and tractor drives; and similar applications. It contains sections and tables on the nomenclature for roller chain parts; chain and sprocket dimensions, and tolerances thereon; space-cutters for sprockets; sprocket-tooth form for block (twin-roller) chains; and working loads and horsepower ratings for chains from No. 35 N (pitch $\frac{3}{8}$ in.) to No. 200 (pitch $2\frac{1}{2}$ in.), for chain velocities from 50 to 1600 feet per minute.

A revision of this standard with a view to

Courtesy American Machinist

American Standards in the mechanical field also serve the aircraft industry

changes in the practical use of roller chains has been under consideration during the last few years.

Code for Pressure Piping (B31)

Scope: Design, manufacture, test, installation, and operation of pressure piping systems.

Sponsor: American Society of Mechanical Engineers.

In 1915 the Power Piping Society published the first specifications for power piping. In 1924 the Ohio Society of Safety Engineers completed a draft of rules for Power Plant Steam and Water Piping. This was followed early in 1925 by a draft of a Code of Safety Rules and Regulations covering the Installation of High and Low Pressure Steam Piping prepared by a committee appointed by the Ohio State Department of Industrial Relations. The distribution of the latter draft made it clear that there was a need for a national code and upon request by the ASME the ASA initiated project B31. The present American Tentative Standard, Code for Pressure Piping (B31.1-1935), represents a standard of minimum safety requirements for (1) the selection of suitable materials, and reference to standard specifications by which they may be secured, (2) the designation of proper dimensional standards for the elements comprising piping systems, (3) the design of the component parts as well as the assembled unit including necessary supports, (4) the erection of these systems, and (5) the test of the elements before erection and of the completed systems after erection.

The Code is meant to serve as a guide to State and municipal authorities in the drafting of their regulations and as a standard reference for minimum safety requirements to equipment manufacturers, architects, engineers, erectors, and others concerned with pressure piping. It contains the following sections: (1) Power Piping Systems; (2) Gas and Air Piping Systems; (3) Oil Piping Systems; (4) District Heating Piping Systems; (5) Fabrication Details; and (6) Materials. An Appendix deals with a Marking System for Fittings and Valves. The section on Fabrication Details contains a chapter, Welding of Pipe Joints, which was prepared with the cooperation of the Pipe Welding Code Committee of the American Welding Society and includes Qualification Tests for Operators of Welding Equipment.

A revision of the Code of 1939 has been under way for several years and is now practically completed. It involves changes in the old sections and the addition of a new section on Refrigeration Piping.

Wire and Sheet Metal Gages (B32)

Scope: The standardization of a method of designating the diameter of metal and metal alloy wire, the thickness of metals and metal alloys in sheet, plate and strip form and the wall thickness of tubing, piping and casing made of these materials; and the establishment of a standard series, or a number of standard series, of nominal sizes and of tolerances for wires, sheets, plates and strips.

Sponsors: American Society of Mechanical Engineers and Society of Automotive Engineers.

Most of the thirty-odd gage systems for wires and sheets are obsolete. However, those still in use cause much confusion because a given gage number indicates different sizes in the several systems. A technical handbook lists nine systems for

steel music wire alone. This has led to the increasing use of decimal inch values for designating wire diameters and sheet thicknesses. The establishment of series of recommended wire and sheet sizes is another problem in this field.

The first step toward national uniformity in this respect is the American Standard, Preferred Thicknesses for Uncoated Thin Flat Metals (Under 0.250 in.) (B32.1-1941). This standard recommends that "for general purpose applications or where requirements permit some latitude in the selection of thickness", a selection be made from the 34 thicknesses, from 0.224 to 0.004 in., listed as preferred. These thicknesses are based on the 20-series of American Standard Preferred Numbers (see Z17.1-1936 p. 339). If intermediate thicknesses are required, the 40-series shall be used.

The draft of a proposed American Standard, Preferred Sizes for Round Wire (0.500 in. and under), is nearing completion and is expected to be distributed to industry for general comment and criticism at an early date.

Hose Coupling Screw Threads (B33)

Scope: Nominal values and manufacturing limits for the dimensions of screw threads for small hose couplings ranging from ½ in. to 2 in. nominal size, and for hose couplings, other than fire hose couplings, with a nominal size larger than 2 in.

Sponsor: American Society of Mechanical Engineers.

The American Standard, Hose Coupling Screw Threads (B33.1-1935), applies to all connections having nominal inside diameters of ½, ⅝, ¾, 1, 1¼, 1½, and 2 in. It was set up to unify existing standards. One of these was prepared and adopted in 1922 by the National Fire Protection Association. The other was prepared by the National Screw Thread Commission and published first in its report of 1924. The pitches of the NFPA threads are coarser than those of the "iron pipe thread" adopted by the NSTC. Both systems had their advocates, but after long discussions the conference method, typical of ASA procedure, led to a compromise. Both systems are represented in the series of hose coupling threads listed in the standard, which are divided into four service groups: Garden and Similar Hose; Chemical Engine and Booster Hose; Fire Protection Hose; and Steam, Water, Air, Oil, and All Other Hose Connections. Detailed thread dimensions are given for hose couplings and nipples.

Dimensions and Materials of Wrought-Iron and Wrought-Steel Pipe and Tubing (B36)

Scope: Standardization of the design, dimensions and material of welded wrought iron pipe, of welded and seamless steel pipe, and of boiler tubing, including pipe and tubing for high temperatures and pressures.

Sponsors: American Society of Mechanical Engineers and American Society for Testing Materials.

To replace the commercial classification of pipe into "standard", "extra strong", and "double extra strong", ASA committee B36 developed a classification based on the Schedule Numbers given in the American Standard, Wrought-Iron and Wrought-Steel Pipe (B36.10-1939), which is the first revision of the edition of 1935. The Schedule Numbers indicate approximate values for the expression 1000 P/S, in which P is the internal pressure in the pipe and S, the allowable stress in the material, both in lb per sq in. Nominal wall thicknesses of welded and seamless steel pipe and welded wrought-iron pipe, computed from a formula containing the variables D (outside diameter of pipe, in inches) and the ratio P/S, are given in the standard, for nominal pipe sizes from ⅛ in. to 30 in. O.D. and Schedule Numbers from 10 to 160. Nominal weights of pipe in pounds per linear foot are also tabulated. There appears to be a tendency on the part of manufacturers, distributors, and users of pipe to continue using the old classification terminology and during the last few years committee B36 has made several efforts to promote the use of the Schedule Numbers which have a sound engineering basis.

American Standard B36.10-1939 lists eleven other American Standards for different kinds of pipe, giving in each case the tensile strength requirements for the material. The present editions of these eleven standards are listed below, with their field of application, which is also given in B36.10-1939.

B36.1-1940, Welded and Seamless Steel Pipe (ASTM A 53-40)—Commercial steel pipe for general uses, also for coiling, bending, flanging, and similar forming operations when so specified.

B36.2-1939, Welded Wrought-Iron Pipe (ASTM A 72-39)—Commercial wrought-iron pipe for general uses, also for coiling, bending, flanging, and other special purposes.

B36.3-1940, Lap-welded and Seamless Steel Pipe for High Temperature Service (ASTM A 106-40)—Lap-welded and seamless steel pipe for high temperature service. Suitable for bending, flanging, and similar forming operations.

B36.4-1939, Electric-Fusion-Welded Steel Pipe, Sizes 30 Inch and Over (ASTM A 134-39)—Covers pipe 30 inches diameter and over in wall thicknesses up to ¾ inch, inclusive, fabricated from steel plates by straight seam or spiral seam electric fusion welding.

B36.5-1935, Electric-Resistance-Welded Steel Pipe (ASTM A 135-34)—Pipe up to 30 inches inclusive intended for conveying liquids, gas, or vapor at temperatures below 450 F. Adapted for flanging, bending, and similar forming operations in Grade A class.

B36.6-1935, Forge-Welded Steel Pipe (ASTM A 136-34)—Covers sizes 14 inches to 96 inches, wall thicknesses ¼ inch to 1¼ inch, forge-welded from steel plates and intended for various uses.

B36.7-1935, Lock-Bar Steel Pipe (ASTM A 137-34)—Covers sizes 20 inches to 72 inches, wall thicknesses 3/16 inch to ½ inch, fabricated from plates with H-shaped lock bars for the longitudinal seams. Suitable for conveying liquids or gases.

B36.8-1935, Riveted Steel and Wrought-Iron Pipe (ASTM A 138-34)—Shop-fabricated pipe suitable for conveying liquids or gases; made from steel or wrought-iron plates with riveted seams.

B36.9-1939, Electric-Fusion-Welded Steel Pipe, 8 Inch to, but Not Including, 30 Inch (ASTM A 139-39)—Covers sizes 8 inches up to but not including 30 inches in wall thicknesses not over ⅝ inch, fabricated from steel plates by straight seam or spiral seam electric fusion welding. Intended for conveying liquids, gas, or vapor at temperatures below 450 F. Adapted for flanging and bending.

B36.11-1939, Electric-Fusion-Welded Steel Pipe for High-Temperature High-Pressure Service (ASTM A 155-36)—Electric-fusion-welded steel pipe having an outside diameter of 18 in. and over for high-temperature and high-pressure service. Suitable for bending, flanging, corrugating, and similar forming operations. Welding in accordance with Par. U-68 of the A.S.M.E. Code for Unfired Pressure Vessels.

G8.7-1941, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (ASTM A 120-41)—Commercial steel pipe for ordinary uses such as low-pressure steam, liquid, or gas lines. Not intended for coiling or close bending, nor for high-temperature service.

Three other standards are listed for the information of the reader, but these have not been approved by the ASA as American Standard. They are:

Line Pipe Specifications (API 5-L, 7th Edition, April, 1940, with Supplement No. 3, August, 1941)—Pipe for line pipe purposes, to convey gas, water, or oil. Sizes covered, ⅛ inch nominal size to 24 inches outside diameter.

Seamless Carbon-Molybdenum Alloy-Steel Pipe for Service at Temperatures From 750 to 1000 F (ASTM A 206-40T)—Seamless carbon—½ per cent molybdenum alloy steel pipe intended for service at metal temperatures from 750 to 1000 F. Suitable for bending, flanging, and similar forming operations, and for fusion welding.

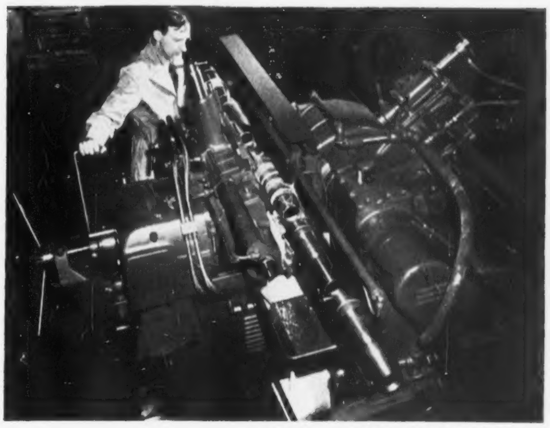
Seamless Alloy-Steel Pipe for Service at Temperatures From 750 to 1100 F (ASTM A 158-40T)—Seamless alloy-steel pipe intended for service at metal temperatures from 750 to 1100 F. Several classes of materials that have been rather extensively used are included. Choice from the respective steels should be made on the basis of requirements of design, service conditions, and the physical properties.

Pressure and Vacuum Gages (B40)

Scope: Nomenclature and definitions of pressure and vacuum gages; capacity ratings; case sizes and mounting holes with a view to obtaining maximum interchangeability; dials and graduations and designation of units; indicator hands and bushings; zero stop pins; bezel rings and their attachment to the gage; connections to the gage; method of expressing allowable errors or accuracy of the gage; requirements for accuracy in so far as establishment of such requirements proves to be feasible; methods of testing; rules and specifications for installation and use of pressure and vacuum gages.

Sponsor: American Society of Mechanical Engineers.

The American Standard, Indicating Pressure and Vacuum Gages (B40.1-1939), applies to round, dial-type indicating gages utilizing an elastic chamber for confining the pressure medium. The nominal size range covered is from 2½ to 12 in. and each of the following subjects is covered by a section of the standard: Nomenclature and Definitions; General Requirements; Sizes and Dimensions; Dial Ranges; Dial Figures; Grades of Accuracy; Graduations; Indicating Pointer; Accuracy Requirements; Test Methods; and Rules for Installation and Use. There are two Appendices, one being entitled "Suggested Gage Purchase Specification Form for General Use of Manufacturers and Users" and the other, "Sample Table Showing Results of the Test of a Gage for Compliance With the Accuracy Requirements." Both are meant only as a guide in the preparation of forms and tables of the kind concerned.



Courtesy Mechanical Engineering

At Work for Defense: Grinding the bourrelet diameter of 155-mm high-explosive shells

Stock Sizes, Shapes and Lengths for Iron and Steel Bars, Including Flats, Squares, Rounds and other Shapes (B41)

Scope: The standardization of the dimensions of cross-sections and lengths of hot rolled and cold finished iron and steel bars having the following shapes: (1) rounds, (2) squares, (3) triangular sections, (4) hexagons, (5) octagons, (6) half-rounds, (7) half-ovals, (8) square-edge flats, (9) nut steel flats, (10) beveled cornered squares, (11) tolerances on the dimensions of the bars included in items 1 to 10 inclusive, (12) reinforcing bars for concrete. Nationally recognized standards are to be accepted where possible.

Sponsor: American Society of Mechanical Engineers.

Two subcommittees of ASA committee B41, one on Hot-Rolled Bars, and the other on Cold-Finished Steel Bars, have submitted reports which are being combined into a single draft of a proposed American Standard to be distributed to industry for criticism and comment.

Leather Belting (B42)

Scope: Specifications for vegetable-tanned leather belting, including raw material, construction, marking, physical and chemical tests.

Sponsor: American Society of Mechanical Engineers.

A draft of a proposed American Standard, Flat Leather Belting, Vegetable-Tanned, Specifications and Horsepower Ratings, has been distributed to industry for comment and criticism. It is based on the Federal Specifications for Flat, Leather, Vegetable-Tanned Belting (KK-B-201) and a standard practice for horsepower ratings adopted by the American Leather Belting Association.

Machine Pins (B43)

Scope: Taper, split, straight and dowel pins.

Sponsors: American Society of Mechanical Engineers and Society of Automotive Engineers.

The draft of a proposed American Standard, Machine Pins, was distributed to industry for general criticism and comment several years ago. It covers taper and cylindrical pins with diameters from 1/16 to 1½ in. The length range is from ½ to 12 in. for taper pins and from ¼ to 8 in., for cylindrical pins. The draft has struck a snag in the form of a controversy about the way of designating the size of a taper pin. In the draft the nominal size of the pin is the diameter of the *small* end. This method is generally preferred by the users of taper pins. However, it is traditional with the manufacturers to designate a taper pin by its *large* end. No agreement on this point has been reached as yet, and doubt has been expressed as to whether an effort to change the existing commercial practice of designation should be made during the present emergency.

Classification and Designation of Surface Qualities (B46)

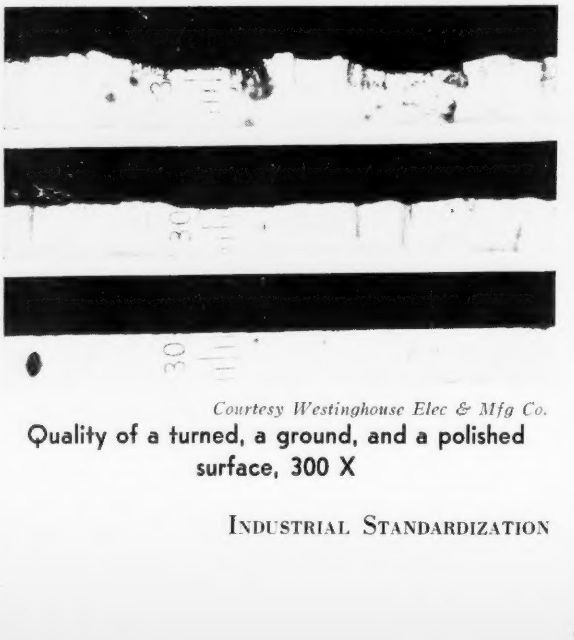
Scope: Classification and designation of surfaces according to quality of surface.

Sponsors: American Society of Mechanical Engineers, and Society of Automotive Engineers.

The crux of the problem faced by the ASA committee on Surface Quality is how to express the "quality" of a surface in terms of measurement, independent of the manner in which the surface has been produced. During the last twelve years, this question has been the subject of wide and thorough investigation in all industrial countries, without a complete solution having been found. One of the main characteristics of a surface is its roughness. After several years of study and discussion, committee B46 has placed at the disposal of industry, for a trial period not to exceed two years, a proposed American Standard, Surface Roughness. This proposal recommends that the roughness of a surface be expressed by the value of the root-mean-square deviation of the surface profile from its central line, in micro-inches. (A micro-inch is a millionth of an inch.) Fourteen main classes of surface roughness, each represented by a maximum permissible root-mean-square value, are proposed. The 14 values step up in accordance with the 20-series of Preferred Numbers (see Z17, p. 339). If none of these classes suits the designer, he can make a choice from 19 subclasses based on the 40-series of Preferred Numbers. Furthermore, a system of specifying roughness classes on drawings is recommended. (This is meant to take care of the symbols to be used with a V-mark on drawings, see footnote 1, page 20, American Standard, Drawings and Drafting Room Practice, Z14.1-1935, discussed on p. 338). The two-year period of trial in practice will end March, 1942. The indications are that the committee will make a number of changes and additions in the draft as published, before passing it on to the sponsors for submittal to the ASA.

Gage Blanks (B47)

In October, 1941, a proposed revision of the American Standard, Gage Blanks (B47-1933), was sent to letter ballot of the Standards Council for approval as an American Standard.[3] This is the second revision of a standard developed by the American Gage Design Committee (an informally organized group of experts) and approved in 1932 by the ASA as the American Standard for Plain and Thread Plug and Ring Gage Blanks, and in 1933, in revised form, under the title Gage Blanks. The latest revision gives details of construction of plain cylindrical plug gage blanks; handles for plain cylindrical and thread plug



Courtesy Westinghouse Elec & Mfg Co.

Quality of a turned, a ground, and a polished surface, 300 X

[3] Since this was written the latest revision, published by the National Bureau of Standards as Commercial Standard CS 8-41, has been approved as the American Standard, Gage Blanks (B47.1-1941).

gage blanks; threaded plug gage blanks; plain ring gage blanks; thread ring gage blanks; taper plug and ring gages for checking taper-lock handles and gaging members; plain adjustable snap gages; adjustable length gages; twin ring gage blanks, and combination ring and snap gage blanks; and master disks. Standard mounting dimensions and other details of dial indicators are also given. A section on Terminology precedes the construction details.

Inch-Millimeter Conversion for Industrial Use (B48)

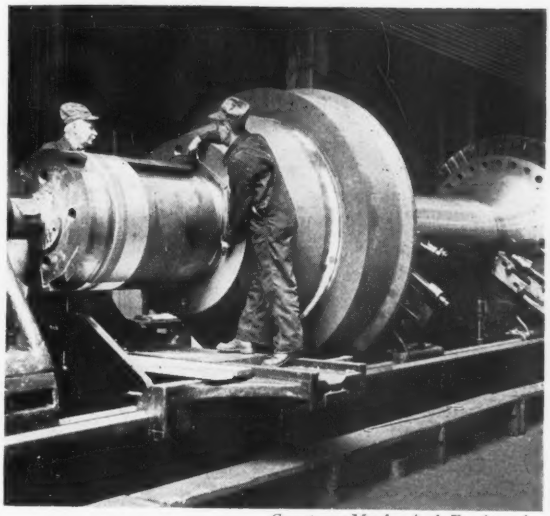
With the increasing refinement of length measurements in industry, difficulties began to arise, some ten years ago, due to different practices of converting inches to millimeters, and conversely. One reason for this was the difference between the official inch-millimeter ratios adopted in Great Britain and the U. S. Another reason was the difference in practice of rounding these ratios and the results of conversions obtained with them. One handbook used 25.40005, another 25.4001 and a third, 25.4. These difficulties were removed through the establishment of the American Standard, Inch-Millimeter Conversion for Industrial Use, B48.1-1933. This recommends use of the inch-millimeter ratio 25.4 and gives rules for rounding values obtained by conversion of inches into millimeters, or conversely. (These rules have been published separately, with a more detailed explanation, as the American Standard, Rules for Rounding Off Numerical Values, Z25.1-1940.) Since the British Standards Institution has also adopted the ratio 25.4, all troubles formerly caused by discrepancies between the "British inch" and the "American inch" have been removed from industrial practice.

Foundry Patterns of Wood (B45.1-1932)

The American Standard, Color System for Foundry Patterns of Wood (B45.1-1932), was adopted by a joint committee of the American Foundrymen's Association, American Society for Testing Materials, Institute of Metals Division of the American Institute of Metallurgical Engineers, Steel Founders' Society of America, and National Association of Pattern Manufacturers. It was published first by the American Foundrymen's Association, and later by the National Bureau of Standards, as Commercial Standard CS 19-32. It was approved by the ASA as an existing standard. The color markings specified in the text and illustrated by a colored sketch are meant to apply to all foundry patterns and core boxes of wood.

Shaft Couplings (B49)

The American Standard, Shaft Couplings, Integrally Forged Flange Type for Hydro-Electric Units (B49-1932), was developed by the ASME Hydraulic Division, adopted by the ASME as a Society standard, and, upon submittal to the ASA, approved as an American Standard. It covers the connecting dimensions of the two halves of a coupling such as used for the connection between the turbine and the generator. The range of shaft diameters covered is from $3\frac{1}{2}$ to 40 in., increasing by half-inch intervals up to 9 in., and by one-inch intervals, from 9 to 40 in. The American Society of Mechanical Engineers, as sponsor, is organizing a sectional committee under ASA procedure, to start work on a revision of this standard to be undertaken upon request of the National Electrical Manufacturers' Association.



Courtesy Mechanical Engineering

Turning a shaft for a 30,000 lb kva large hydroelectric unit

Unification of Rules for the Dimensioning of Furnaces for Burning Solid Fuel (B50)

(Proposed) Scope: The work of this committee shall be limited to consideration of the combustion space required for the burning of bituminous coal at a rate not to exceed 1500 pounds per hour of 12000 Btu per lb coal as fired with mechanical firing equipment of all types installed in (*a*) low pressure boilers and warm air furnaces, and (*b*) high pressure boilers.

Sponsor: American Society of Mechanical Engineers.

This project was started upon the request of the American Society of Mechanical Engineers that a standard practice be set up for the setting of small boilers to ensure furnace volume adequate for complete combustion. Five subcommittees have been organized, to deal with: (1) Scope; (2) Combustion and Design; (3) Warm Air Furnaces; (4) Steel Heating Boilers; and (5) Cast-Iron Boilers. A field survey and an experimental study at Battelle Memorial Institute have been planned. However, the work has been practically suspended due to the requirements of the defense program.

Classification of Materials for Tools, Fixtures and Gages (B52)

Scope: The establishment of a standard classification, based on performance requirements, of tool steels and other materials for tools, fixtures and gages.

Sponsor: American Society of Tool Engineers.

The classification of tool steels on the basis of performance is one of the most important problems to be solved under this project, which was requested by the American Society of Tool Engineers. However, the project also concerns materials other than steels, such as cemented carbides and stellite. Committee B52 held its organization meeting in May, 1941, where it was decided to appoint a subcommittee to determine the basis on which the classification of materials for tools, etc. should be made, and the scope of the work to be undertaken by each of the subcommittees as such a classification would require.

Some Projects Other Than Mechanical

Scheme for the Identification of Piping Systems (A13)

Scope: Identification of piping systems in industrial and power plants which are not buried in the ground; with special reference to personal hazards in times of accident at a plant; including conduits for the transport of gases, liquids, semi-liquids or plastics, but not including conduits filled with solids.

Sponsors: National Safety Council, and American Society of Mechanical Engineers.

The American Recommended Practice, Scheme for the Identification of Piping Systems (A13-1928), was set up to harmonize all specifications for the identification of piping systems in industrial plants (not including pipes buried in the ground and electric conduits) on the basis of the character of the gases, liquids, semi-liquids, or plastics conveyed by the piping. (The standard does not apply to piping systems for the transport of solids carried in air or gas.) Particularly, the intention of the standard is to establish a uniform basis of ready distinction between pipes that carry unsafe materials and those that carry safe ones. It applies also to fittings, valves and pipe coverings, but not to supports, brackets or similar accessories. The standard recognizes five main classes of materials carried in piping: Safe Products (S); Dangerous Materials (D); Protective Materials (P); Extra Valuable Materials (V); and Fire Protection Equipment (F). All materials carried in the pipes of a given plant are to be assigned to one of these main classes and identified by colors given for each of these classes, and by color stripes or legends. An Appendix gives a classification of a number of materials under S, D, P, V, and F, and a practical example of the standard to piping used in paper and pulp mills.

Quality Control (Z1)

Scope: The establishment of methods, means and practices for the application of statistics to the specification and control of quality of materials and manufactured products.

Autonomous ASA Project.

The ASA started this project in 1940 upon request of the War Department and, due to the national emergency, decided to handle it under the ASA Defense Emergency Procedure. A committee of six members has completed two American Defense Emergency Standards, Guide for Quality Control (Z1.1-1941) and Control Chart Method of Analyzing Data (Z1.2-1941), published in a single pamphlet, May 1941. Additional standards are under consideration and the draft of one of these, Control Chart Method of Controlling Quality During Production (Z1.3), is expected to be ready soon for a canvass of a number of interested key individuals. These standards are of great interest to the mechanical industry for several reasons. They make it possible to refine control of quality of manufactured product during production, as well as control of quality of materials and components supplied from the outside.

Drawings and Drafting Room Practice (Z14)

Scope: Classification of and corresponding nomenclature of drawings in accordance with their purpose, method of representation of the subject, including arrangement of views and sections, use of lines of different kinds and thickness, indication of dimensions, tolerances, and fits, tapers and slopes, and surface or finish, symbols for elements, indication of materials by cross-hatching, arrangement of borderline, title, part list, notes, changes and revisions, method of folding and punching, kinds and sizes of lettering, figures and symbols, scales of reduction and enlargement, sizes of drawings and filing cabinets, width of rolls of paper and cloth, size of drafting equipment and tools, specifications of materials to be used for drawings and drafting. Exclusive of Architectural drawings.

Sponsors: American Society of Mechanical Engineers, and Society for the Promotion of Engineering Education.

To establish a uniform code in the field of engineering drawing, the American Standard, Drawings and Drafting Room Practice (Z14.1-1935), was developed after a thorough canvass and long discussion of existing practices in individual companies. It contains the following sections: Arrangement of Views; Lines and Line Work; Sectional Views; Dimensioning; Screw Thread Representation for Bolts and Threaded Parts; Trimmed Sizes of Drawing Paper and Cloth; and Lettering. In some cases more than one method is given in the standard on account of their wide use in practice. For example, vertical, as well as inclined, lettering is recognized as standard practice. On the other hand, from two widely used

unit sheet sizes for drawings, 8½ x 11 in. and 9 x 12 in., only the former is recommended as standard because it matches the most widely used commercial letterhead. Recently, a new subcommittee was organized to review the 1935 standard and bring it up to date where necessary. This work has already been started.

A second American Standard in this field, Drawings and Drafting Room Practice, Graphical Symbols (Z14.2-1935), gives symbols applying to plumbing; piping; pipe fittings and valves; heating and ventilating; heat-power apparatus; conventional rivets; and electric power and wiring.

Preferred Numbers (Z17)

Scope: Development of a system of numbers in geometric series for use in standardization.

Autonomous ASA Project.

Preferred Numbers are series of numbers to be used for standardization purposes in preference to any other numbers. In 1927 a table of Preferred Numbers was informally approved and published by the ASA for a trial in practice. In 1931, the ASA organized committee Z17 which developed the American Standard, Preferred Numbers (Z17.1-1936), keeping in close touch with the work done on this subject by a committee of the International Standards Association (ISA). The Basic Preferred Numbers, Decimal Series (10 to 100), in the American Standard are the same as in the ISA system. They comprise five series with the approximate step-ups between consecutive numbers given here in parentheses: 5-series (60 per cent); 10-series (25 per cent); 20-series (12 per cent); 40-series (6 per cent); and 80-series (3 per cent). The standard also gives series of Preferred Numbers in binary fractions from ⅛ to 40 (5-, 10-, 20-, 40- and 80-series), to be used only for linear dimensions in inches where binary fractions are in common use. Above 40, and below ⅛, the decimal Preferred Numbers should be used. The 5/2, 5/3, 10/3, 20/3 and 40/3-series are given as supplementary series in the decimal and the binary systems. They have approximate step-ups of 150, 300, 100, 40 and 18 per cent, respectively.

Speeds of Machinery (Z18)

Scope: Standardization of speeds of machinery and of such elements of mechanical power transmission as are functions of said speeds.

Sponsor: American Society of Mechanical Engineers.

This project was undertaken upon the request made to the ASA by the National Machine Tool Builders' Association that a standard be set up for speeds of driven machinery, such as machine tools, pumps, compressors, etc. A general conference called by the ASA recommended that the scope of work be widened to include also speeds of driving machinery, particularly electric motors.

Courtesy Mechanical Engineering

Assembling 75-mm Pack Howitzers

Complete interchangeability of parts and close manufacturing tolerances are required here

A proposed American Standard for Machine Speeds was published for general criticism and comment in 1933. It gives definitions for the speed of a driving unit and the speed of a driven unit, with illustrations of six types of drive in common use. A table of a proposed standard series of speeds for driving units and driven machines is included. Its range is from 22 to 54,000 r.p.m. No further progress has been made.

Rounding Off Numerical Values (Z25)

The question how to round numerical values was fully discussed first in connection with the establishment of the American Standard, Inch-Millimeter Conversion for Industrial Use (B48.1-1933) (see p. 337), which contains rules for such rounding. By decision of the general ASA conference that dealt with the inch-millimeter problem, these rules, together with a detailed explanation of their background, have also been published separately in the American Standard, Rules for Rounding Off Numerical Values (Z25.1-1940). The most important recommendation is to round a 5 not followed by any number other than 0, to the next even decimal place. For example, 6.35 should be rounded to 6.4 and 6.25, to 6.2.

New Zealand and Canada Act to Make Standards Mandatory

A TREND toward mandatory as opposed to voluntary standards has been shown recently in reports from both New Zealand and Canada.

In Canada the Wartime Prices and Trade Board announces that it will issue orders to enforce standard practices throughout an industry whenever it is necessary and desirable in the interest of economy to do so.

In New Zealand, the House of Representatives has passed a Standards Bill placing all responsibility and authority for standardization in the hands of the Minister of Industries and Commerce and giving him control over the preparation, promulgation, and application of standards. The Bill sets up a Standards Council of from 12 to 25 members, all of whom, as well as the chairman and deputy-chairman, are to be appointed by the Minister. The functions of the Council will be to make recommendations to the Minister on the formulation and on the promulgation and application of standard specifications; to promote research in connection with specifications and to provide for testing of commodities and processes; to supervise the registration and use of standard labels; and to cooperate with those outside New Zealand who have similar duties.

Provides for Certification

The Bill also provides for the registration of standard marks as certification trade marks, to contain or consist of the words, "New Zealand Standard," "N.Z. Standard," or the letters "NZS." Applications for licenses to register standard marks are to be made to the Minister, who is empowered to grant them if he is satisfied that the commodities, processes, and practices conform to standard specifications. No such license shall be granted for more than one year but it is deemed to be renewed from year to year unless specifically revoked. The license-holder must submit, on request, a sample of the article in question for sampling or testing. The Minister may revoke a license after giving 14 days' notice if he is not satisfied that the commodity, process, or practice conforms to a standard but the holder is authorized to lodge an objection.

The Bill also stipulates that before a standard can be declared, the Minister must obtain a report from the Standards Council and consult the firms and individuals engaged in the industry concerned.

Will Use Power for Price Regulation

Objections to the Bill were raised in New Zealand on the ground that it makes standardization compulsory and that it gives the Governor-General authority to demand that an industry conform to approved standard specifications. There was also objection to the fact that the right of appeal is to the Minister instead of to the court.

During the debate on the Bill, the Minister stated that the compulsory clause would be used only for the purpose of protecting the public against fraud and deception, against dangerous and deleterious goods, and for the purpose of price control and price regulation. He declared that in his opinion it is hopeless to attempt to build industry in New Zealand unless it is based on the foundation of standards. In this connection he said, "Due to shortage of manpower and the strain on supplies, it will be necessary to concentrate our manpower, machinery, and national energy into narrower fields."

The announcement of the Canadian action was made by Donald Gordon, new chairman of the Wartime Prices and Trade Board, who said: "It is obvious that business is faced with the immediate necessity of making economies wherever possible. Moreover, as shortages of labor and materials and machinery become more and more acute, the necessity for economies in production and distribution, for standardization of products and elimination of unnecessary varieties, styles and models and, in general, for the most economical use being made of all available resources, will become increasingly important.

Board Will Enforce Standard Practices

"Industry already knows many things which might be done but which for one reason or another, chiefly perhaps for competitive reasons, have not yet been put into effect.

"The board wishes to emphasize that every business which takes the earliest opportunity of effecting such economies will be that much better off in the long run and wherever it is necessary and desirable to enforce standard practices throughout an industry, the board will issue the necessary order."

Engineering Problems in Dimensions and Tolerances[1]

by W. W. Werring
Member, Technical Staff, Bell Telephone Laboratories

Functional Dimensioning

Effect of Tolerances

If apparatus parts are minute or have complicated relative motions it is recognized that manufacturing drawings to the usual scale have serious limitations to their usefulness in the analysis of the effects of combination of tolerances. In such cases designers frequently make layouts to larger scales or large-scale adjustable models to investigate the effect of variations on functioning. Illustrations of this practice are numerous in the experience of most designers of small apparatus.

Even in large parts which are stationary in use the application of tolerances, in effect, establishes several possible positions for each element and may present problems similar to those involving motion. These are not easily recognized because of a curious limitation inherent in small-scale drawings. This limitation is probably well known to most engineers but it is worthwhile to analyze it because it is important to be always aware of it.

This limitation is the fact that in drawings the shape of the part and the effect of all nominal dimensions are actually shown graphically, whereas it is possible to indicate tolerances numerically but not graphically. We are therefore apt to visualize the part as it is graphically shown, that is, without tolerances and to think of the numerical tolerances one at a time rather than in combinations as they affect each other and the shape of the part.

If any dimension, significantly affecting the design of a part, is changed, the drawing is immediately corrected so that its meaning will be clear and the functioning of the part can be checked. This obviously facilitates design and manufacture. Yet because they cannot be shown directly by regular drawing methods, we have grown accustomed to not being shown the effect of tolerances or changes in tolerances upon the shape of the part. Nevertheless it is obvious that these effects are critical in the functioning of the part or tolerances would not be set. The fact that these critical features of the design are not actually graphically shown and therefore are not easily seen and understood on the drafting board is a serious detriment in working out a design and in all later analysis of it. The full effect of interrelated variations, particularly if in three-dimensional space, may appear only after tools are in process or the first parts produced and this may be rather late for economy.

Originally this difficult analysis of the effect of tolerances upon functioning probably involved only the designer. The manufacturer tried to make the part as nearly as possible to the nominal values shown and variations from them were accidental. Tolerances were looked upon as an indication of the care required and as a means of inspection for acceptance or rejection. With increasingly complex manufacturing tools the permitted tolerances are utilized more and more in the design of tools to allow the greatest possible wear before defective parts are produced and the tools must be replaced. For mass-production parts progressive step type tools are used in which a continuous strip of stock advances by various stages from blank sheet to finished part. Tools of this type are extremely expensive and in order to obtain maximum life full use of allowed variations is made in their design. Design of such tools and the gages required to maintain quality in mass production therefore also requires analysis of the effect of combinations of variables upon the desired part. As the designer has presumably already made this analysis, and incidentally is best qualified to do it, economy and accuracy dictate that his analysis be transmitted to the manufacturing engineer. The problem is to find means by which he can indicate unmistakably on the drawing his analysis of the

[1] This article, dealing with Functional Dimensioning, is part of an article on Engineering Problems in Dimensions and Tolerances by Mr. Werring published in full in the *Bell System Technical Journal*, April. Mr. Werring's discussion of Raw Material Sizes and Dimensional Tolerances, also part of this article, was published in the November issue of Industrial Standardization, pp. 285-290.

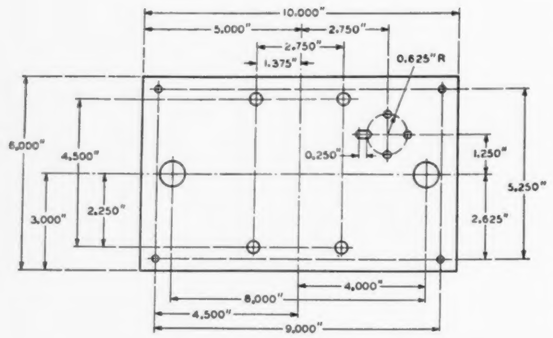


FIGURE 5[2]

Flat plate dimensioned without tolerances

required functioning of the part and the manner in which he intends the tolerances to apply, in the event that there is any possibility of misunderstanding.

The essence of this problem and some of the possibilities of solution can best be seen by reference to drawings which illustrate the major points.

Figure 5[2] shows the drawing of a flat plate dimensioned from center lines but without any tolerances whatever. Some minor dimensions not involved in this discussion are omitted in the interest of simplification but the part shown is in every way a normal one. The meaning of the drawing is completely clear and can be interpreted in but one way no matter from what standpoint the analysis is made. The reason for this is obviously that but one value is shown for every dimension.

Figure 6 shows this same drawing dimensioned in exactly the same way with the exception that tolerances are shown for most of the dimensions. To the uninitiated it might appear to present no more problem than the previous drawing without tolerances because of the tendency to visualize the drawing in terms of the nominal dimensions only.

When the engineer analyzes the effect of the combinations of the various tolerances shown, interesting questions immediately arise. In the first place the combination of holes dimensioned 1.25 in. ± .002 in. from the center line appears to be definitely located because on the drawing the center line is shown in a definite position. Yet when the tolerances are considered the center line of this drawing could actually be shown in several different places as, for example:

1. It may be a line through the centers of the two large holes.
2. It may be a line anywhere from 2.992 in. to 3.008 in. from the outside edges.
3. It may be 2.247 in. to 2.253 in. from the small holes in the center of the plate.
4. It may be 2.615 in. to 2.635 in. from the holes numbered 2 and 4.

In brief, the center line which appears so definitely located on the drawing may actually be rather an indefinite location on the part when the various tolerances are considered. While the differences in the possible interpretations are in the order of thousandths of an inch, nevertheless this order of magnitude is critical in this part or the indicated tolerances would not have been used. The interpretation of the center line which should be adopted will depend entirely upon the manner in which the part is intended to function and therefore should be indicated by the designing engineer. Obviously, not all designs or all dimensioning will present this difficulty but all should be studied from this viewpoint to determine whether or not they do.

Functional Datum Positions

When the type of uncertainty illustrated exists, it is necessary to indicate clearly the effect of tolerances on functioning by establishing the functional positions to which dimensions should refer. It may be difficult to do this graphically, in which case it is necessary to indicate by notes the particular interpretation which the designer intends. As an example, if the part of Figures 5 and 6 functions by being located in position by means of the four holes numbered 1, 2, 3 and

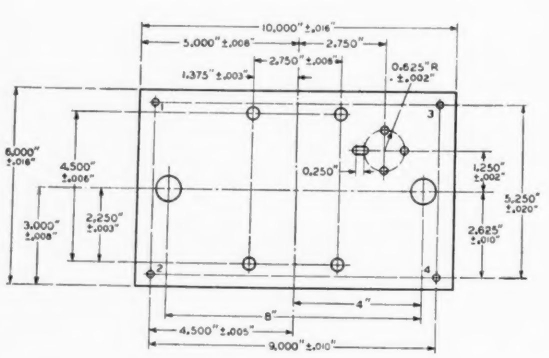


FIGURE 6

Flat plate of Figure 5 with the addition of tolerances

[2] Figures 1-4 appeared in Mr. Werring's discussion of Raw Material Sizes and Dimensional Tolerances, INDUSTRIAL STANDARDIZATION, November, pp. 285-290.

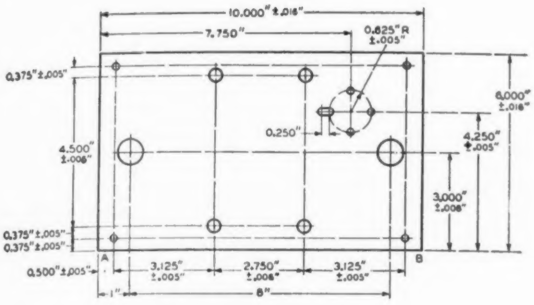


FIGURE 7

Flat plate of Figure 5 functionally dimensioned from outside edges with tolerances

4. the intentions of the designer are readily indicated by the following notes:

1. Functional datum line I is midway between the centers of holes 1 and 2 and the centers of holes 3 and 4.
2. Functional datum line II is perpendicular to datum line I at a point midway between the centers of holes 2 and 4.

These notes establish both horizontal and vertical center lines specifically in terms of the center of the one set of dimensions between the holes marked 1, 2, 3, and 4. The term *functional datum line* is suggested as completely descriptive but other equivalent terms might be used. This information could be indicated on the drawing without the use of notes by the adoption and use of some standard convention or symbol to indicate the particular dimension bisected by the center line.

If the functioning of this part were determined by location against the outside edges, this could be readily indicated by dimensioning the part as shown by Figure 7 and using notes establishing the line A-B as one datum line and the perpendicular to it through A as the other.

In either of these cases the drawing becomes completely definite and subject to only one interpretation. In drawings of this type no change in the method of dimensioning may be required and the problem is solved simply by the addition of suitable notes or symbols indicating the intention of the designer as to functional datum lines.

It is sufficient to establish datum lines in the case of parts which are practically flat pieces with little depth but when a part has substantial depth it will be noted that center lines or other datum lines on a drawing really represent planes in space. In such parts it becomes necessary to establish datum planes rather than lines and three planes at right angles to each other are required.

Figure 8 illustrates such a part which might be an armature such as is used in many pieces of electrical contacting apparatus. In the typical operation of such a part its functioning is determined by the relation of its various dimensions to the position of the pole face and the axis support. In order to indicate this on the drawing it is necessary to establish dimensioning as shown and add to the drawing the notes shown.

These notes establish three functional datum planes, the first through the axis at the point of support and a distance .265 in. from the pole face area; the second at right angles to the first through the axis of support; and the third at right angles to both the first and second and halfway between the finished surfaces 1.578 in. apart. With these planes established the application of all the limits and tolerances shown is based on the operating position and analysis of the design is simplified. The drawing and the intentions of the design engineer cannot be misunderstood.

The clear expression of the designer's intentions by datum plane dimensioning will be appreciated by all concerned with the drawing or the resulting part. Inspection of the part is expedited no less than production. The inspector can usually by means of gage blocks or simple fixtures set the part up on a surface plate as indicated by the drawings' datum planes and

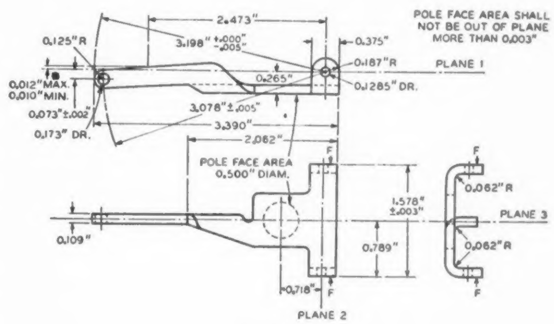


FIGURE 8

Functional datum plane dimensioning of magnetic armature type of part

Functional datum plane I passes through the common axis of the two .1285 in. diameter holes and .265 in. above the pole face gage position.

Functional datum plane II is perpendicular to plane I and passes through the common axis of the two .1285 in. diameter holes.

Functional datum plane III is perpendicular to planes I and II and passes midway between the finished surfaces which are 1.578 ± .003 in. apart.

positions. He can then establish the conformance of the part with the drawing by simple measurements to the indicated horizontal and vertical planes. When production quantities justify special gages the required design of the gage is established clearly by the datum planes.

Invariable or Gage Dimensions

The drawing of Figure 8 just described illustrates the use of gage dimensions. The dimensions .265 in. and .718 in. and the indicated half-inch diameter for the pole face are all gage dimensions without tolerances and some statement must be made or understanding reached that they are considered invariable and tolerances not permitted. They represent, it might be said, theoretical dimensions, on the drawing, or in practice they represent tools or gaging apparatus made to the highest standards of accuracy. These invariable dimensions are necessary in order to establish a starting point for the dimensioning of the part. It may appear at first that stating that a dimension has no manufacturing tolerance or variation is a hardship upon the manufacturer but this is not really so because the dimensions are not ones which are actually manufactured in the part. They represent usually dimensions built into tools or gaging equipment which are made to a precision greatly superior to that represented by part tolerances.

Invariable dimensions, or better, gaging dimensions or whatever it is proposed to call them are really not a new invention and it is possible to cite easily recognized examples. For instance, the dimension 2.473 in. on Figure 8 is an invariable gaging dimension not associated with the setting up of datum planes but typical of long standing use of invariable dimensions. We all can recall also the use of the term "theoretically correct position" and it is present practice in the case of vacuum tube bases and similar apparatus to designate the location of the contact studs in terms of a gage having holes located on "true centers." Last but not least a minimum or maximum limit in its application is itself an invariable dimension.

In effect, datum lines or planes established when necessary by use of invariable or gaging dimensions remove the uncertainty as to the designer's intentions and prevent misunderstandings between design, production, and inspecting engineers. Admittedly they do not completely solve all problems of dimensions, as probably nothing will. They do, however, transfer whatever problems remain from the field of tolerances on finished product to the realm of tool-making tolerances and gaging tolerances. The problem of how invariable is "invariable" remains but we are obviously then considering differences of an order of magnitude not usually vitally significant in the functioning of product parts. Theoretically, all "invariable" dimensions should be taken to the best accuracy of good gaging methods which means that any differences of opinion will be reduced at least to one-fifth and probably to one-tenth of the order of magnitude of those where tolerances themselves are involved.

It will be necessary to specially identify gaging dimensions on drawings to distinguish them from ordinary unlimited dimensions and to indicate that they are dimensions for gages to which only gage tolerances apply.

Practical Use of Datum Lines and Planes

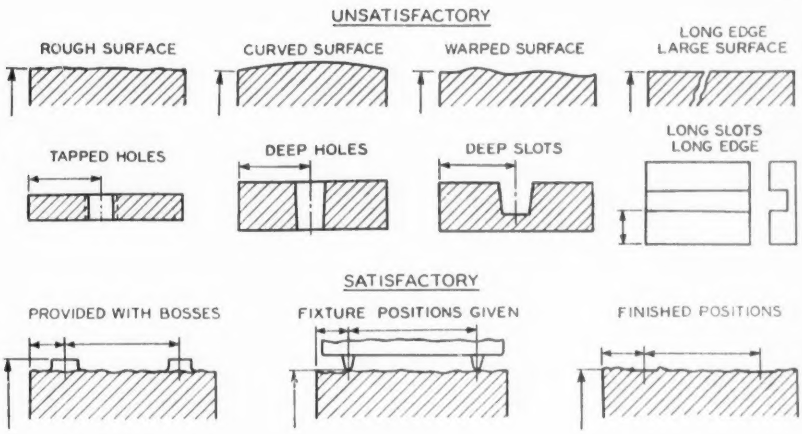
It is not usual to establish datum lines on all drawings but if their use is necessary in the layout and design of the part they need to be permanently identified. This use of datum lines and planes on drawings, where necessary, may require somewhat greater drafting effort in the actual production of the drawing but their use results in a simplification of design and of the work of those subsequently using the drawings. It reduces the effort expended in analysis of drawings preparatory to the construction of tools and minimizes the possibility of misunderstandings or errors in tools. In products manufactured only intermittently it is particularly valuable, as it minimizes the need for understandings and instructions supplementary to the drawings which may be forgotten between production periods or lost through shifts in personnel.

The overall economy in engineering effort and the reduction of the numerous possibilities of error more than compensate for the increase in the actual work of indicating datum positions, lines, or planes upon drawings. In addition, the choice of design of punches and dies and similar tools by production engineers is better guided by the designer's requirements if functional datum lines are clearly identified. An obvious example is the use of either the inside or outside of a punched and formed part as the starting point. In brief, datum plane dimensioning is a more explicit expression, on the drawing, of the designer's "end point requirements."

When establishing datum planes, it is important to consider them in terms of the actual physical part rather than in terms of the drawing. Lines which appear as definite points on a drawing may not be actually part of the product when it is completed or may be on surfaces shown as a line on the drawing but rough or unfinished in the part. It is difficult to establish any set of rules covering what shall or shall not be done because each drawing and each part must be considered practically as an individual case. That this is so will be amply demonstrated by a serious study of even one part. However,

FIGURE 9

Types of datum positions



there are obvious generalities which can be established and Figure 9 shows some of them.

An example of functional datum plane analysis and dimensioning in three dimensions of a complicated part is shown by Figure 10. This is the die cast frame for a special selector switch. It is the base upon which many interrelated parts and subassemblies are mounted. The proper functioning of the completely assembled switch depends in large measure on proper manufacture of this casting. In effect, the switch is designed around a vertical shaft passing through points P and Q, and planes 1 and 2 are, therefore, established through the axis of this shaft. The production planning engineers intend to design the die and withdraw die plugs from such directions that the mounting surfaces will be smooth, flat, and without any taper and they intend to use these surfaces as guiding points for their jigs and fixtures. It is for this reason that Plane 1 is established parallel to these mounting surfaces and an indicated distance from them. The other planes are established as shown on this drawing and described by the notes. With this arrangement of planes the designer's analysis in terms of Plane 1 is easily worked out and the reference of Plane 1 to the mounting surfaces permits the production or tool engineer to translate the design of the part into the design of his tools without necessity for further analysis and without the possibility of different interpretations. It will be noted that invariable or gage

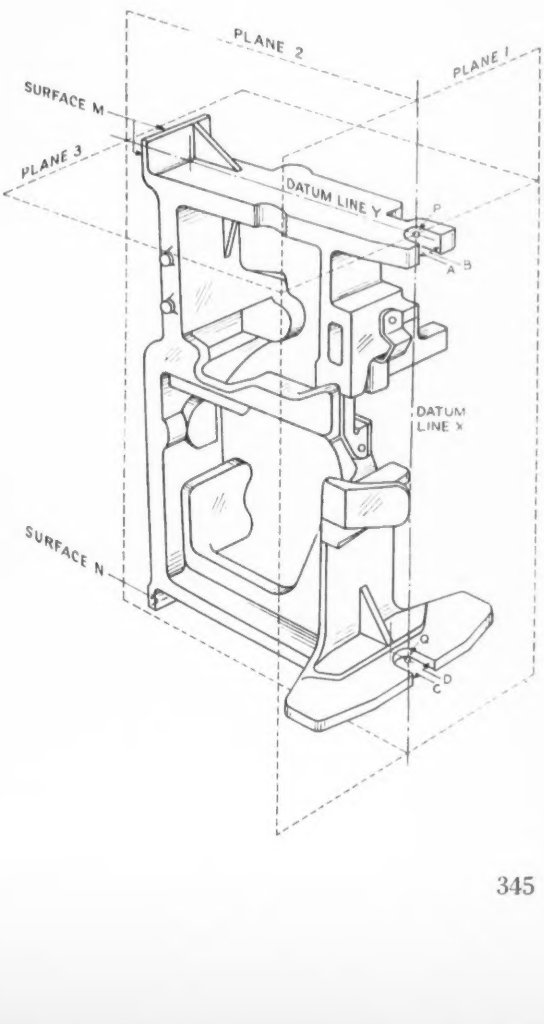


FIGURE 10

Functional datum planes of complicated switch frame

Dimensions to datum line "X" or "Y" of the drawing of the frame refer to functional datum planes 1, 2, or 3 described below. Points "P" and "Q" are gage points used in establishing these datum lines and planes. Points "P" and "Q" shall be half-way between the surfaces "A" and "B" and "C" and "D" respectively and 4.358 in. from the plane of surfaces "M" and "N" on the mounting lugs.

Datum line "X" shall pass through the points "P" and "Q".

Plane 1 shall be parallel to surfaces "M" and "N" and shall include datum line "X".

Plane 2 shall be perpendicular to plane 1 and shall also include datum line "X".

Plane 3 shall be perpendicular to plane 1 and to plane 2 at the point "P".

Datum line "Y" passes through point "P" and is the intersection of planes 2 and 3.

dimensions are again used. The complete drawing of this part is very complicated and occupies a drawing practically 4 ft x 6 ft. The perspective sketch shown and the accompanying notes are incorporated in the drawing as a separate view.

Required Standardization

It is not suggested that the drawings shown and the notes referred to represent a final practice on datum planes. A standard practice in designation of planes, and standard terminology and understanding on gage points and gage dimensions is required. It will probably be desirable to adopt some symbol or designation for use on drawings to distinguish gage dimensions which are invariable from ordinary unlimited dimensions to which manufacturing engineers for their own purposes usually add shop tolerances. One thing is certain and that is that datum planes, dimensions, and tolerances when established should be primarily in terms of the required functioning of the apparatus. When that is done no one using the drawing in any capacity will have any doubts as to the designer's intention and this results in a great reduction in the discussions and analysis which might otherwise be necessary.

Summary

In summary it may be said that the whole approach to these problems in dimensions and tolerances should be on the basis of functioning. However, good engineering of dimensions and tolerances requires knowledge of what can reasonably be produced and the sources of reasonable tolerance values are:

1. Raw material limits, including some knowledge of future trends and developments.
2. The normal accuracy of manufacture, also including anticipation of future improvement.
3. Discussion of trend of design with manufacturing engineers.

Solution of tolerance problems in the final design may involve all of the following steps:

1. Study of the effect of combinations of tolerances on functioning allowing for statistical effects in accumulations of tolerances.
2. Discussion of this analysis with the production planning engineer because the analysis of tolerance combinations is important in the design of long life tools.
3. Indication of the results of such an analysis by the method of dimensioning drawings.
4. Indication on drawings of functional datum positions, lines, or planes established on geometrically correct principles to permanently and unmistakably record the intentions of the designer regarding combinations of variations wherever this is necessary.

New Association Standards

Since the publication of the November issue of INDUSTRIAL STANDARDIZATION, the ASA Library has received for its classified files copies of standards and specifications from the organizations listed below.

These standards may be consulted by ASA Members at the ASA Library.

Anyone desiring copies for his own use should write direct to the organization issuing the standard.

Associations and Technical Societies

American Petroleum Institute (Division of Production, 1205 Continental Building, Dallas, Texas)

Casing, Drill Pipe and Tubing, Suppl 1 to API Std 5-A, 11th ed August 1941

Setting Depth Properties of Casing, API Code 5-C-2, 1st ed August 1941 25¢

Line Pipe, Suppl 3 to API Std 5-L, 7th ed August 1941

Oil Well Pumps, API Std 11-A, 6th ed October 1941 $1.25

Steel Geared Speed Reducers, API Std 11-E, 4th ed August 1941 35¢

Chain Drive Speed Reducers, API Std 11-E-1, 2nd ed August 1941 25¢

Rating of Hoisting Equipment, API Std 11-G, 2nd ed August 1941 25¢

(An official list of the Publications of the API Division of Production, Bulletin S-2, 19th ed, October 1941, is also available.)

American Society for Testing Materials (260 So. Broad Street, Philadelphia, Pa.)

Petroleum Products and Lubricants, ASTM Standards September 1941 $2.00

Electrical-Heating and Resistance Alloys, ASTM Standards September 1941 $1.25

Textile Materials, ASTM Standards October 1941 $2.00

Compressed Air Institute (90 West Street, New York, N. Y.)

Trade Standards, 5th ed 1938 $1.00

Drop Forging Association (605 Hanna Building, Cleveland, Ohio)

Standard Tolerances for Forgings 1937

Heat Exchange Institute (90 West Street, New York, N. Y.)

Condenser Section Standards, 2nd ed 1940 $1.00

Typical Specifications for Surface Condensers and Auxiliaries for Turbine Service 1940 Included with Condenser Section Standards or 25¢ separately

Steam Jet Ejector and Vacuum Cooling Section Standards 1938 $1.00

Deaerator and Deaerating Heater Section Standards 1940 75¢

Hydraulic Institute (90 West Street, New York, N. Y.)

Standards—General, Centrifugal Pump, Rotary Pump, Reciprocating Pump, Deep Well Turbine Pump, Test Code, Data—7th ed 1940-41 $1.25

Code for the Measurement of Water Using Standard ISA Orifices with Free Discharge 1941 $1.00

ASA Standards Activities

Approved Standards Available Since Publication of Our November Issue

Gypsum (ASTM C22.25) (Revision of A49.1-1933) American Standard A49.1-1941
Impact Resistance of Electrical Insulating Materials, Methods of Test American Standard C59.11-1941
Black and Hot-Dipped Zinc-Coated (Galvanized) Welded Seamless Steel Pipe for Ordinary Uses (ASTM A120-36) (Revision of G8.7-1937) American Standard G8.7-1941
Zinc Oxide (ASTM D79-39) (Revision of K22-1939) American Standard K22-1941
Basic Carbonate White Lead (ASTM D81-38) (Revision of K23-1938) American Standard K23-1941
Red Lead (ASTM D83-39) (Revision of K24-1939) American Standard K24-1941
Mineral Iron Oxide (ASTM D84-40) (Revision of K25-1940) American Standard K25-1941
Lampblack (ASTM D209-30) (Revision of K26-1937) American Standard K26-1941
Chrome Yellow (ASTM D211-40) (Revision of K27-1940) American Standard K27-1941
Reduced Chrome Green (ASTM D213-40) (Revision of K28-1940) American Standard K28-1941
Prussian Blue (ASTM D261-40) (Revision of K29-1940) American Standard K29-1941
Reduced Para Red (ASTM D264-40) (Revision of K31-1940) American Standard K31-1941
Bone Black (ASTM D210-30) (Revision of K36-1937) American Standard K36-1941
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Distillation of Gas Oil and Similar Distillate Fuel Oils, Methods of Test (ASTM D158-41) (Revision of Z11.26-1938) American Standard Z11.26-1941
Distillation of Crude Petroleum, Methods of Test (ASTM D285-41) (Revision of Z11.32-1936) American Standard Z11.32-1941
Distillation of Plant Spray Oils, Methods of Test (ASTM D447-41) American Standard Z11.43-1941
Vapor Pressure of Petroleum Products, Methods of Test (ASTM D323-41) American Standard Z11.44-1941
Calculating Viscosity Index, Method (ASTM D567-41) American Standard Z11.45-1941
Conversion of Kinematic Viscosity to Saybolt Universal Viscosity, Method (ASTM D446-39) American Standard Z11.46-1941
Graphical Symbols for Use on Drawings in Mechanical Engineering (Revision of Z14.2-1935) American Standard Z32.2-1941

Standards Now Being Considered by Standards Council for ASA Approval

Keyways for Holes in Gears B6.4
Cast-Iron Pipe Flanges and Flanged Fittings, Class 250 (Revision of B16b-1928)
Safety Code for Jacks B30
Gage Blanks (CS8-41) (Revision of B47-1933)
Protection of Structures Containing Inflammable Liquids and Gases—Part 3 of Code for Protection Against Lightning (From status as American Tentative Standard to American Standard) C5, Part 3
Dry Cells and Batteries (Revision of C18-1937)
Rubber Gloves for Electrical Workers (ASTM D120-40) C59.12
Tubular Sleeving and Braids, Methods of Testing and Tolerances (ASTM D354-36) (Revision of L13-1941)
Use of Explosives in Anthracite Mines, Proposed American Recommended Practice M27
Drinking Fountains Z4.2
Safety Code for Laundry Machinery and Operations (From status as American Tentative Standard to American Standard) Z8
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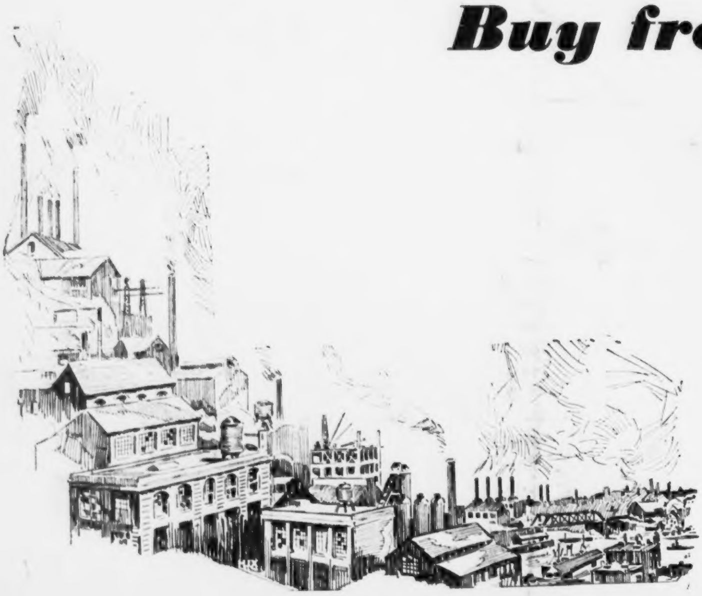

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